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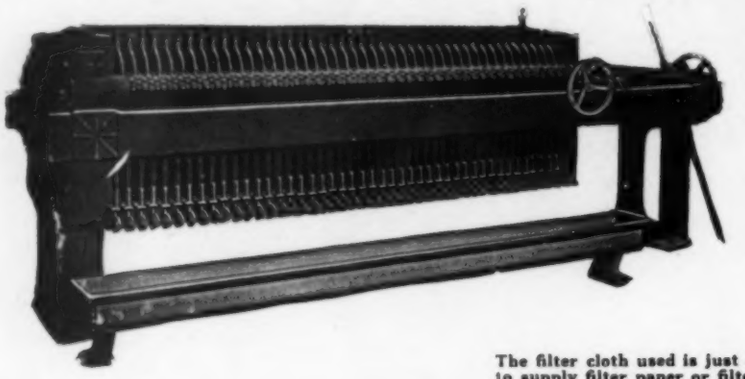

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# CHEMICAL & METALLURGICAL ENGINEERING

*A consolidation of*
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

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## The Evil of the Tax-Free Security

EXPERIENCE of the past few years has made it very clear that the tax-exempt security and the progressive income tax cannot live in peace together. The tax-free bond tends to destroy the graduated feature of the income tax. That the tax rate shall increase with the increase in the size of the individual's income is a principle which has been firmly established in the code of equity of every civilized people, and the man who predicts that the people in this country will tamely submit to the nullification of progressive income taxes is a very blind prophet indeed. To be sure, most students of the problem agree that the federal income tax scale has been pushed to a height which is difficult to justify and that it should be modified as soon as the fiscal exigencies of the Treasury will permit. But income taxation, graduated to very substantial levels, is here to stay, and the warping, distorting effects of the tax-exempt security would probably survive even the most radical revision of the income tax that lies within the realm of possibility.

The opportunity—or rather the compulsion, for it is an opportunity which the rich man must be economically insane to ignore—to invest in tax-exempt bonds has brought about a revolution in the normal investment habits of large owners of capital. Persons who normally could place their funds in public utility or industrial bonds now must ignore such offerings unless, indeed, the utilities or industries chance to be publicly owned. The result has been unfair to private industries in a double sense. Not only are they shut out from their customary market for money but at the same time competing public undertakings are given a subsidy in the form of abnormally cheap money.

The extent to which this country has indulged in tax-exempt securities was recently brought out before the Ways and Means Committee in a striking manner. It was testified that there are between 10 and 15 billions of state and municipal tax-free bonds in existence and a further 3 billions of United States bonds are totally exempt. In addition there are outstanding about 18 billions of United States bonds containing certain exempt privileges for the next 3 years, so that it may be safely said that the total of tax-exempt securities lies between 20 and 30 billions of dollars. Just what proportion of this amount has been spent on developments other than the agencies of production and distribution is not known and is difficult to estimate. But it is evident that with such temptations for public extravagance, our efforts to achieve economy in public affairs are very seriously threatened.

Whatever his views may be regarding the severity of the surtaxes in the present federal income tax, the business man will be wise to regard as a separate issue any proposals for their reduction. The only surtaxes nullified by the tax-exempt securities are those applying to investment or "unearned income." Moreover the nullification of these rates is at the cost of a derangement of the investment market, in misdirected economic effort and, consequently, in waste. The only feasible road back to normalcy is to be rid of the tax-exempt bond.

## The Artistic Temperament In the Practice of Chemistry

SOMETIMES the talk over a club table is worth repeating. Five or six men were at luncheon to the accompaniment of speculative discourse. "I hardly think," said one of the number, referring to a leading chemical technologist, "that he succeeded because of any mathematical bent of his mind. The man is primarily an artist and has the real artistic temperament. I don't mean the hysterical emotion of an opera singer; I mean the sense of rightness. He hates waste rather because it indicates the wrong way to produce than because it is economically wrong. His sense of form and color is such that he would have succeeded as a painter, a sculptor or an architect, if the curiosity that makes chemists had not gained possession of him. He abhors a mess of any kind. An inadequate yield produces waste, and waste again is usually a mess, which is contrary to his artistic sense."

This called to mind another eminent chemist whose contributions to pure science are known the world over. He has mathematics available and uses it as a tool, as a short-cut to reach his conclusions, but he does not worship mathematics as his less gifted brethren do. This man, in addition to his major work, practices one of the fine arts as an avocation.

One of the party suggested that all good chemists are born, not made, but he could not get a discussion of his postulate, because it led into the tiresome old dispute as to heredity or environment being of leading weight in influencing a man's career.

Agreement was reached, however, that curiosity, the untiring curiosity of a child, the drive to find out, is a leading requirement of anyone who would devote his life to the application of chemistry. Most of those present insisted that an active and projective imagination is of equal importance. Now this is the equipment of the true artist: the keen imagination that sees things as he is convinced they should be. A defective reaction offends him. His curiosity eggs him on to study it, but his artistic temperament will not let him rest until he has discovered the reaction of his ideal, the way to do the thing as it should be done.

At the conclusion of the discourse the impression prevailed that any chemical engineer who reaches the

heights must be an artist in his work. He may be a master at manipulation, an extraordinary craftsman, but if he lacks the needful imagination, the art of seeing things as they should be, before they are made, he cannot reach the front rank. Chemistry and the fine arts are closely related.

## Is Public Education Worth What It Costs?

OFFHAND the average American will answer this question with a strong affirmative, but probably he will reckon without a knowledge of all the facts. The expenditure for education in the United States has been mounting upward by leaps and bounds, as is clearly set forth in the 1922 annual report of the Carnegie Foundation for the Advancement of Teaching. The president of the Foundation, Dr. HENRY C. PRITCHETT, is plainly concerned over the trend in public education; and the astounding figures that he presents make us pause and wonder whether we are on the right track.

The expenditure for primary and secondary schools in the United States—i.e., for grade and high schools, as we call them—has risen from $140,000,000 in 1890 to over $1,000,000,000 in 1920. The enrollment in public or grade schools has risen during the same period from 13,000,000 to 22,000,000—an increase of 70 per cent—while the enrollment in public high schools jumped from 200,000 to over 2,000,000, or an increase of more than 1,000 per cent. The increase in college attendance has been likewise a striking feature, although figures are not given. It appears, however, that while attendance at grade schools has kept pace with the increase in population, that of high schools and colleges has advanced at a rate of growth several times the rate of increase in population. In 10 years the cost of education per capita has increased from $34 in New York State in 1910 to $106.97 in 1920. This is only an example.

It is pleasing to think that so much is done for education in this country and that there is such a widespread interest in the subject. But, as Dr. PRITCHETT says, "it is possible to dissipate enormous sums of money in the name of education which serve neither to equip children with a body of knowledge nor to train their minds, nor to instruct them as to their duties and rights under the government through which the education is furnished." His protest is that with such increasing costs we may soon reach a burden that is too heavy for the respective communities to bear. "In no country in the world," he says, "does so large a proportion of the energy of the teaching profession devote itself to the tedious task of lifting ill-prepared children and youths through courses of study from which they gain little or no good."

Our interest is in technically trained men and in skilled workmen who know how to use their hands and are willing to use their heads. We do not want them to learn to loaf on their jobs at school. We want our technical men not only to have thorough training in physics, chemistry and engineering, but in addition to this we want them to have the consciousness that they are professional men with professional obligations in the community.

We think the signs of the times point to a simpler and less expensive government with compulsory grammar school education. Secondary and higher education should be for those who want it and are competent to achieve it. Others gain no profit from secondary and higher education, although the expense of trying unsuccessfully to train them is indeed becoming a tax that may grow too heavy to meet.

The attitude on the part of business toward education in the United States is disclosed in a recent referendum conducted by the Chamber of Commerce of the United States on the question of a federal Department of Education with a Secretary in the President's Cabinet, and the principle of federal aid to education in the states on the basis of an equal share of the expense. It is significant that the referendum disclosed a strong opposition against both proposals. A third one relating to the enlargement of the present federal Bureau of Education brought out a strong negative vote but not sufficient to commit the Chamber against the proposal. Evidently business in the United States, as represented by the constituent bodies of the National Chamber, has sensed something of the conditions brought out in Dr. PRITCHETT'S report, and feels that we may well pause and take stock of our efforts at education before we go further.

## What Causes Variations in Lime?

ELSEWHERE in this issue we publish a note by OLIVER BOWLES of the Bureau of Mines which is suggestive and stimulating. It seems that not so very long ago a woman, Miss SQUIRE, president of the Allwood Lime Co., completed a series of test burnings on different kinds of limestone which led to the isolation of one in particular. This stone on burning yielded a special lime that sold for as high as $200 a ton—a good wholesome dollars-and-cents reason for wondering just what it is about a limestone that affects the lime produced from it.

Of course one very obvious variation is impurity, but apparently that is not the only factor nor yet the significant one. In a given limestone bed there are many strata and the different layers yield widely variant limes. Why? Is the variation a regular and progressive function of the depth? Not at all. It is true that in general the older strata will be denser, and this, of course, will have its effect. But from a geological point of view the various conditions prevailing at the time of sedimentation, such as the density of the medium, the origin of the calcareous material, the time required, etc., all affect the variety of limestone deposited. These conditions may have changed frequently in the deposition of any given bed, so that the strata vary irregularly and may change every few inches.

There is a large school that still adheres to the idea that differences in lime are due to differences in method of burning. This undoubtedly has a distinct effect, but indications have almost reached the point of conclusive proof in showing that it is not the whole story. A careful systematic study of the fundamental properties of burned limes, together with historical data as to their origin, will probably be necessary before a comprehensive answer can be given. Of course these historical data must be specific enough to distinguish between the different limestones in the same quarry. The problem seems to offer not only a wonderful opportunity for constructive research but a fertile field for play of imagination as well. And the solution may conceivably revolutionize some phases of a tremendous industry.

## The Vertical Trust In American Industry

THE tendency toward the adoption of the vertical trust by American industry becomes more evident with each passing month. Recent news items from the glass-manufacturing district near Pittsburgh report the purchase by the Ford Motor Co. of the Allegheny Plate Glass Co., with a yearly production of 7,000,000 sq.ft., and the purchase by W. C. DURANT, of Durant Motors, Inc., of the American Plate Glass Co., with 6,000,000 sq.ft. annual production. These are only the latest of a long series of similar items, typified by the Ford control of mines, railroads, blast furnaces, coke ovens, artificial leather factories and, in fact, of almost all the various agencies that go to make the complete motor car or enter into its production in any way.

While the automotive industry provides, perhaps, the most conspicuous examples of this "vertical" type of organization, the tendency is fully as marked in industries which are more strictly chemical and metallurgical. For examples, we might point out the Newport Chemical Works, organized, as its slogan reads, "From coal to dyestuff"; or the Aluminum Company of America, which controls its product from mine to consumer. Numerous other examples of more or less well-developed vertical trust will come quickly to every mind. The tendency is already well founded and is evidently rapidly increasing.

Now, therefore, while this growth is still in its infancy it will be profitable to study it somewhat and ask ourselves what it holds in store for chemical and related industry. Consolidation into larger units seems to be the necessity of the day. Obviously, to change from our customary method of "horizontal" mergers to the "vertical" method will have some effect. It will be well for industry to consider what this will be while the movement is still young, so that the necessary steps can be taken to meet the new kind of competition that will result.

## Atomic Speculation

A MASS of evidence—much of it derived quite recently from X-ray studies—indicates that solid solutions are dispersions of atoms (not molecules) in the solvent, and these "stranger atoms" replace their hosts at or very close to the exact position in the normal space lattice of the solvent metal. This replacement or substitution, atom for atom, is accompanied by distortion of the space lattice, more or less extensive, and a correspondingly greater amount of internal energy in the crystal.

DR. WALTER ROSENHAIN, in his recent lecture before the Institute of Metals (presented in digest elsewhere in this issue), develops beautifully several logical deductions from the above discoveries. Undoubtedly none of his hearers but admired the way he argued his conclusions, showing how they corresponded with known metallurgical facts. He was thus enabled to group many of the metals into classes showing combinations of properties, in striking agreement, yet so far having escaped notice.

In the face of this achievement, it is easy to let criticism sleep. Yet we think it will not be captious to point out that it is possible our eminent guest has at one place drawn out the theory a little too fine. To explain the phenomenon of the mushy stage, he notes that the solvent atoms immediately surrounding the stranger will melt with it first because of their distorted positions, to be followed at higher temperatures by the next layers, less and less disturbed from their normal lattice and containing less and less potential energy.

If one agrees that the stranger atoms locate the points where fusion begins, it is hard to see why the distorted lattice should remain disturbed after the cause of the disturbance has been removed, especially since at temperatures near melting the atomic mobility is large and the rigidity of the lattice is low.

Apparently it is necessary to avoid getting too close to the infinitesimal limit—there must be a sort of mass action—else it would be easy arithmetic to figure each atom of solute to influence just a few solvent atoms, in this region the concentration being high enough to melt. This reduces us to the rather absurd position that all the solvent atoms must enter the liquid state as soon as the first one melts.

A more attractive explanation is contained in a recent communication from FRANCIS B. FOLEY. Consider a cooling solution, like carbon steel. When the temperature reaches 1,530 deg. C., the melting point of iron, there is a definite tendency for cubic crystals of pure iron to form. Doubtless such aggregation of iron atoms does take place, but the alloying tendency of carbon is also present, and atoms of carbon assume some position on these elementary crystals, distorting their structure so that everything immediately disrupts and re-enters the liquid state. The liquidus is reached when the atomic attraction of the iron lattice is just sufficient to overcome the kinetic disturbances of high temperature and the distortions caused by diffusion of the correct amount of carbon into the crystal.

On this supposition, at any temperature in the mushy stage there is an interchange of both solvent and solute atoms between the solid and liquid phase, and melting occurs by the entrance of an excessive amount of stranger atoms into a lattice already strained near the breaking point by harboring many guests.

Another point where we would make a suggestion: Dr. ROSENHAIN supposes that diffusion occurs by a stranger atom moving in a short line, pushing ahead a long line of atoms and dragging behind a tail long enough to reach from the grain boundary. This involves what appears to be very large forces. Is it not more reasonable to suppose that only a small group of atoms rotate?

Assume, for instance, that the stranger occupied the face center on a cubic system. The four corresponding atoms of the lattice unit might interchange places in cyclic manner, the action being repeated with new partners as often as necessary for the stranger to find its last resting place. This involves breaking bonds on four atoms only instead of many thousands. The objection that the atoms are keyed against rotation would hold with equal force against movement by translation—if the corner atoms key the face-centered atoms against rotation, the face-centered atoms also key the corner atoms against translation. The most attractive thing about diffusion by rotation of a unit lattice or a part of it is this: The action is extremely local, and occurs within a region where the lattice is already distended by the mere presence of the solute atom.

# Readers' Views and Comments

## Accelerated Reactions in Pulsating Gaseous Currents

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—The article in your issue of Dec. 27 entitled "Accelerated Reactions in Pulsating Gaseous Currents," by J. Deschamps and J. F. Shadgen, and the comments by various correspondents which have appeared in several issues since then have interested me greatly. My interest is largely due to the fact that I have had a practical application of the principles advocated by Deschamps and Shadgen under observation for several years and I should like to call attention to one phase of the subject which I believe has not been brought out by any of your correspondents.

We have here a Gayley dry air blast plant for drying the air supplied to the blast furnaces by refrigeration. In this system air is forced into a chamber by a fan and passed over a nest of pipe coils cooled by means of the circulating refrigerated brine. On these coils the moisture condenses. The air is then led by means of a duct to the suction side of the blowing engines. In one case these engines are of the reciprocating type and the varying demands they make on the air supply as the different engines get into step and fall out of step cause rather strong pulsations of air pressure in the refrigerating chamber. These fluctuations of pressure are of the order of 2 or 3 oz. per square inch and have a frequency of about thirty to sixty per minute.

When I came here several years ago I was struck by the fact that the moisture content of the air leaving the refrigerator was always appreciably below that corresponding to the temperature of saturation. The most satisfactory explanation for this result that I can give is as follows: On entering the refrigerator one immediately notices the fluctuations in air pressure by the somewhat unpleasant sensation on one's ear drums. Then he will notice what seems to be a flickering of the lights in unison with the pulsations of air pressure. Upon closer examination it will be observed that at each rarefaction a fog forms, causing a halo around each light which disappears at each compression. The air has evidently been cooled so that the water vapor is near its point of saturation and since in every pulsation the part of the cycle representing an expansion is accompanied by a drop in temperature some of the vapor condenses to form a fog. Now if in that part of the cycle representing a compression the accompanying rise in temperature causes a complete re-evaporation of this fog, then these pulsations will cause neither a loss, except through friction, nor a gain, except inasmuch as they improve the circulation of the air among the coils as argued by Messrs. Deschamps and Shadgen. But as long ago as 1870 Sir W. Thompson demonstrated that a small drop will evaporate in air containing so much moisture that condensation would take place on a flat surface. (See Chapter XX, Capillarity, in "Theory of Heat," by Clerk Maxwell.) Consequently if any of these small drops in the fog formed during a rarefaction come in contact with any surface, they will immediately flatten out and will not re-evaporate in the compression half of the cycle. The effect of this will be to maintain the absolute humidity below that corresponding to the saturation humidity at the average pressure and temperature of the air. The amount of this condensation is dependent on the amplitude and frequency of the pulsations of pressure. In fact, it would be quite possible to extract a large part of the moisture of the air with only cold water in the pipes by increasing the variations in pressure.

The point I am trying to bring out is that if a certain reaction is influenced by the pressure, then in a varying pressure a lowering of the pressure will not always undo the effect brought about by the raising of the pressure or *vice versa*. In some cases this can be made to be of advantage.

A. E. MUELLER.

Maysville, Wis.

## They All Aspire

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—Apropos your editorial in the issue of *Chem. & Met.* dated Feb. 21, relative to the popularity of the term "engineer," the following was clipped from a recent issue of the New York *Tribune*:

### Everybody's One of 'Em

No longer little Micky Hare,
  Whose ways are wild and meek,
Will keep my clothing in repair
  For 50 cents a week.
He now demands a larger sum,
  Which I esteem too dear,
For lately Michael has become
  A Pressing Engineer.

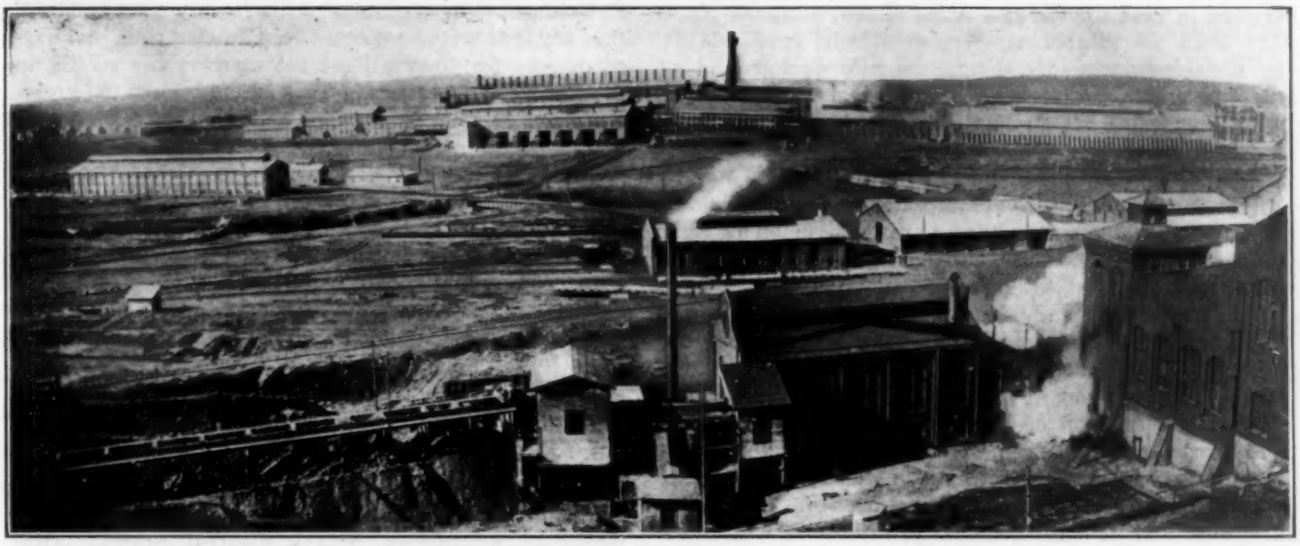
The days when Tonio Dorio
  Would clip and trim my lawn
And make my kitchen garden grow
  For ten a month are gone.
He now is making wads of pelf,
  Takes contracts by the year,
And on his billheads styles himself
  A Mowing Engineer.

The lads from Greece who cleaned my shoes
  Once in a cheaper time
Now with a haughty scowl refuse
  My little proffered dime.
One sees them by appointment now,
  They're risen, it appears,
And have become, so they avow,
  Shoe Surface Engineers.

Old 'Rastus Johnson comes no more
  To take the cans away,
Or knocks upon the kitchen door
  To seek his weekly pay.
He's found a means of getting his—
  The dusky profiteer—
His card informs me that he is
  A Garbage Engineer.

It would seem that in the profession of chemistry one also finds those who, though not doing work which can be classed as that of a chemical engineer, have taken over the name at least. I have in mind one man who holds a high position in a large concern. This man is in reality a chemical engineer and performs such work. So disgusted has he become, however, at the tendency of all professions to adopt the term engineer, and in particular the tendency of all chemists to describe themselves as "chemical engineers," that he refuses to allow himself to be so designated, preferring to be known as an "industrial chemist."

New York City. PAUL D. V. MANNING.



PANORAMA OF PLANTS 2 AND 4 OF THE ATLAS PORTLAND CEMENT CO., NORTHAMPTON, PA.

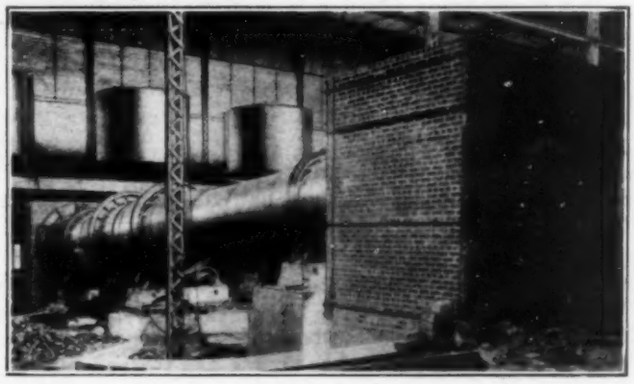
# A Pioneer Passes

## An Appreciation of the Work of the Late Harry J. Seaman, of the Atlas Portland Cement Co.

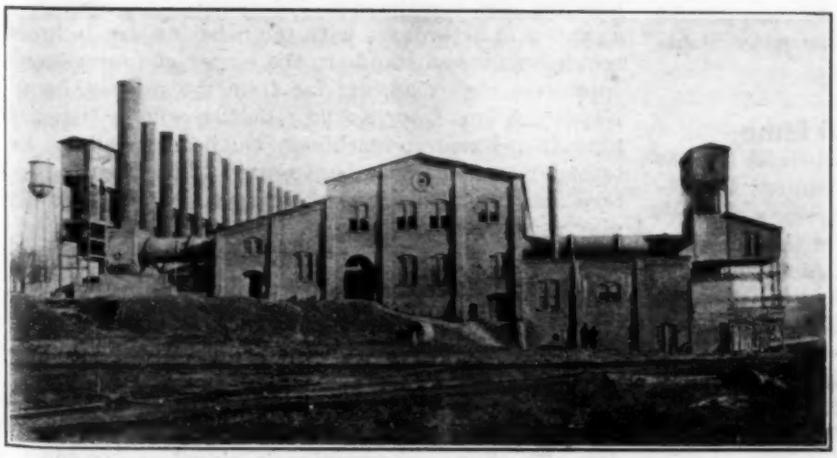
H. J. SEAMAN

IT IS perhaps almost a truism among those who are familiar with technical progress to say that it is seldom dramatic. Certainly as an industry or a process develops, the steps by which it progresses are so gradual, so almost imperceptible, that at times and for long periods it may seem to stand still. Yet if, for some reason, there is occasion to review a long period, the elements of the dramatic appear. Progress has been stupendous and amazing, the imperceptible steps have slowly but surely achieved a revolution. So when the announcement of the death of Harry J. Seaman appeared in the daily press, a host of friends paused in retrospect and realized, many with surprise, that a great leader and pioneer had died. An unfailing courtesy which had endeared him to his colleagues and subordinates, and a most retiring modesty, had militated against a popular appreciation of his excellent work.

He was graduated in chemistry from Lafayette in 1879, and with 13 years of experience in metallurgical work he came in 1892 to be superintendent of the Atlas Portland Cement Co., which was then being organized. During his first years in the cement industry many costly experiments were being made in an attempt to use oil for firing the kilns, and Mr. Seaman, with an associate, an English engineer named Hurry, began a series of experiments on the use of pulverized coal in cement burning. There was something approaching the dramatic in the application of these experimental runs to plant work. A large plant was constructed, using pulverized coal as a fuel, but the plant was also equipped with oil-burning appliances as a precautionary measure and to some extent to throw competitors off the trail. The operation of this plant was carried on for 2 years before many of the competitors realized the secret of its success. A whole industry then followed his lead. In the accompanying photograph of the Northampton plant, it is interesting to note that the brick building in the foreground is the original coal-pulverizing building



EARLY 60-FT. KILN



224-FT. KILN, CAPABLE OF TURNING OUT 1,800 BBL. CEMENT PER DAY

erected in 1894 for the new Atlas cement company plant. The kilns in this plant were relatively small, 6½ ft. in diameter by 60 ft. long. In the background of the same photograph is plant No. 4, erected in 1904, with kilns still 6½ ft. in diameter but 135 ft. long. There followed, step by step, the construction of larger and larger kilns. In 1906 a unit 8 ft. 5 in. in diameter by 135 ft. long; in 1909, 10 ft. in diameter by 224 ft. long, and finally, in 1910, four kilns were constructed 12 ft. in diameter by 233 ft. long. During the 22 years in which Mr. Seaman was at the helm of the Atlas, the company grew from a small industrial plant of seven kilns to the huge organization operating 103 kilns with a combined output of 50,000 bbl. a day. This in 1914 made it the largest cement plant in the world. A severe illness then robbed Mr. Seaman of his energy and for 2 years he had virtually retired from active work. But during the war he was instrumental in the installation of potash-recovery systems to remove the potash from the cement kiln dust and he combined this process with waste-heat boiler installation and a complete elimination of flue dust from the kilns. The combination of these installations was unique and again represented pioneer work.

It is appropriate that we should pause for a momentary appraisal and appreciation. Mr. Seaman gave a high type of service to his company, to the industry and to the public. In its detail of progress, it was seldom dramatic, but as a whole it presents a picture which will serve as an inspiration for many years.

## Present Situation in the German Glass Industry

In a recent trade dispatch from Berlin concerning the German glass industry, it is reported that in the table glass branch of the industry deliveries of raw materials have been difficult to obtain. Demand in the home market has decreased, but this decline is thought to be temporary and all the plants are very busy at present with orders on hand. Encouraging reports of the improvement in trade come from the East, Italy, Rumania and German Austria.

The hollow glass industry has experienced considerable difficulty in procuring raw material. In spite of the consequent increase in price of raw material, the finished article has not advanced unreasonably. The recent fall in the value of the mark has revived foreign trade in some measure, but the small orders received will not be sufficient to keep the various plants in operation for any length of time. A further decrease in coal supplies will render it necessary to close many plants entirely.

## Specifications for Chemical Lime

The rapid increase in the use of commercial lime as a chemical in recent years has been recognized in technical circles throughout the country. There is no more striking evidence of this than the action of the American Society for Testing Materials in establishing standards for lime for chemical uses. The first of these chemical lime specifications appears in the 1922 Tentative Standards of the A.S.T.M. covering the use of lime in the varnish, paper, textile and silica brick industry.

Work upon specifications for lime for all its other many chemical uses is now actively in progress by the A.S.T.M. committee C-7 on lime through its sub-committee on chemical lime under the chairmanship of Dr. M. E. Holmes. Other technical societies are co-operating in this work and it is expected that in due time standards of quality for lime will be set up covering all its important chemical uses. This should lead to greater efficiency in lime production and greater economy and quality in the use of lime.

## Record Production in 1922 of Fuel Briquets

According to the United States Geological Survey, a record production for fuel briquets was established during 1922, when the total output amounted to 619,425 net tons. In 1920, 398,949 tons were produced.

FUEL BRIQUETS PRODUCED IN THE UNITED STATES IN 1917-1922

| Year | Net Tons | Value | Year | Net Tons | Value |
|---|---|---|---|---|---|
| 1917..... | 406,856 | $2,233,888 | 1920..... | 567,192 | $4,623,831 |
| 1918..... | 477,235 | 3,212,793 | 1921..... | 398,949 | 3,632,301 |
| 1919..... | 295,734 | 2,301,054 | 1922..... | 619,425 | 5,444,926 |

The deficit in domestic anthracite in the region supplied by the upper Lake docks resulted in a greatly increased production in the Central States. Other districts have also reported an encouraging increase. The same type of binder has been generally used and a similar raw fuel constituent employed in the various plants.

RAW FUELS USED IN MAKING BRIQUETS IN THE UNITED STATES 1919-1922, IN NET TONS

| Fuel | 1919 | 1920 | 1921 | 1922 |
|---|---|---|---|---|
| Anthracite culm and fine sizes and semi-anthracite..... | 118,595 | 356,877 | 190,964 | 254,563 |
| Semi-bituminous and bituminous slack and coke..... | *97,387 | *125,506 | 121,925 | 235,542 |
| Lignite, sub-bituminous coal, and oil-gas residue..... | 80,383 | 89,656 | †85,352 | †123,339 |
| | 296,365 | 572,039 | 398,241 | 613,444 |

* Includes no coke. † Includes no brown lignite.

Of the fourteen plants that operated, six used anthracite culm or fines, two semi-anthracite, one a mixture of anthracite fines and bituminous slack, one semi-bituminous slack, one a mixture of bituminous slack and sub-bituminous coal, two carbon residue from the manufacture of oil gas, and one bituminous coal, first subjected to low-temperature carbonization. The total quantity of raw fuel used was 609,186 net tons, of which 42 per cent was anthracite or semi-anthracite, 39 per cent semi-bituminous slack, bituminous slack and coke, and 19 per cent sub-bituminous coal and oil-gas residue.

## First Glass Factory in Lithuania Completed

In a recent trade report from Berlin it is stated that the construction of the first glass factory in Lithuania has just been completed at Petrasuoni. The factory is equipped in accordance with the most modern technical requirements and stands in the center of four villages, opposite a high road, not far from the railway, on the Niemen, 5 km. from Kovno. Bottles will be the main product and modern machinery has been installed. Extensive peat fields have been rented 3 km. from the factory and special machinery has been installed for digging peat.

## Production of Alcohol in Poland

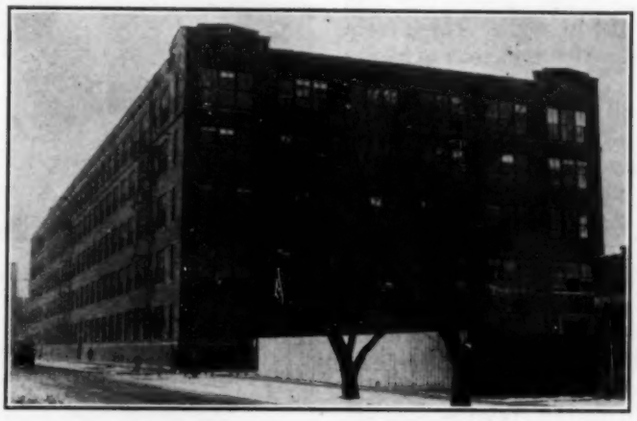
Of the 2,000 agricultural distilleries existing before the war, 1,420 are at present in operation within the territory of the Polish Republic. The estimated production of the agricultural and industrial distilleries during the present campaign is 1,200,000 hl. of alcohol of 100 deg. The home consumption is placed at 600,000 hl., leaving the same quantity for export.

# Wall Paper Manufacture In a Model Mill*

**Hanging Paper Made on Fourdrinier Machines Is Coated With a Clay Slip, Giving a Surface Upon Which the Design Is Printed With Lake Colors Suspended in an Adhesive Medium**

MURAL decoration is a subject which in all probability dates back to the crude effects obtained by primitive man when he varied the monotony of bare walls of his cave by draping them with skins of animals. Later, with the development of textile arts, woven materials were largely used, and from the eleventh to the middle of the eighteenth century the tapestry industry flourished. Cloth painted in imitation of tapestry subsequently became popular and it is but a short step from this to the use of paper as a base. Printing ink and ordinary hand presses were used at first, followed by the process of printing from hand blocks, which is still in use for particularly artistic effects.

About 1839 Potter and Ross, in England, began investigations which resulted in the adaptation of calico-printing machinery to the printing of wall paper. It is to this development that the modern machine-printed wall paper industry owes its origin.



EXTERIOR VIEW OF A MODEL MILL

This is a very interesting branch of the paper industry and yet very little technical information is available regarding it. Accordingly the following outline of processes employed by a mill which has many unusual features may be of interest. The mill, which is that of Sears, Roebuck & Co., Chicago, occupies a 5-story building provided with a thirteen-car siding from the tracks of the Baltimore & Ohio Chicago Terminal Railroad. As the mill has a capacity of 30,000,000 rolls of wall paper per year, the need for adequate transportation facilities is evident.

In the trade, it is customary to refer to paper base upon which the design is printed as hanging paper, while the finished wall paper is termed paper hangings. Several paper mills make hanging paper, which is then sold to other firms more properly referred to as wall paper printers than as wall paper manufacturers. The latter term implies plants in which the whole series of operations is carried out. The Sears, Roebuck & Co., mill is of this type, being a self-contained unit. The paper is made, the colors are prepared and the printing is done all within the establishment.

Waste paper of various kinds—catalog trimmings, office waste, records, overissue newspapers, etc.—is reduced to pulp together with a certain amount of groundwood and sulphite, coloring matter and sizing. The groundwood and sulphite are received in the form of laps, bales or rolls. The pulping operation is begun in pulpers and beaters of the usual type, the mill being equipped with two 2,100-lb. Niagara and one 1,750-lb. Allen beaters. The beater furnish varies according to the type of hanging being made, since it would not be possible to obtain some of the lighter colored effects on stock which might be perfectly satisfactory for a dark shade.

When the stock in the beaters or pulpers has been properly disintegrated it is discharged to concrete stuff chests, which serve to store the pulp until it is fed to the Jordan engines, which complete the pulping operation by separating the cluster of fiber still more. The pulp then passes to a set of stuff chests, which keep it in suspension so as to insure a uniform feed to the paper machine.

For forming the paper, a 132-in. Fourdrinier machine is provided. When running on hangings the full width of the machine is not used, but it is adjusted to give a trimmed sheet 117 in. wide, since this will just make six rolls wall paper width, 19½ in. The main portions of the machine are driven by a steam engine, although some of the accessories are motor operated. The speed is 500 to 550 ft. per minute.

Just before entering the flow box on the machine the pulp passes through two rotary screens to remove any coarse fibers which might be present. It then flows at uniform consistency and at a carefully regulated rate onto the endless 65-mesh Fourdrinier wire. The first part of the machine is given a shaking motion at right angles to the direction of flow so that as the water drains through the screen by gravity and the fibers begin to form a sheet they will not point in the same direction but will interweave to produce a strong well-formed sheet. Removal of water is accelerated near the end of the screen by oscillating suction boxes placed under the screen. In these a vacuum equivalent to several inches of water is maintained by motor-driven Nash Hytor pumps. While the paper is in a fluid condition it is kept from flowing off the sides of the screen by two endless deckle-straps of vulcanized rubber about 2½ in. square in cross-section. These are so mounted that they travel with the screen, and the width of the sheet may be varied by adjusting the distance between them.

After passing the suction boxes, the sheet is passed over a suction couch roll. This roll, together with the breast roll at the head of the machine, forms the support upon which the Fourdrinier wire is stretched. This suction couch roll removes enough of the remaining

*This article is based upon an address delivered before the Chicago Chemists' Club by Herbert A. Hauptli, superintendent of Wall Paper Mills, Sears, Roebuck & Co.

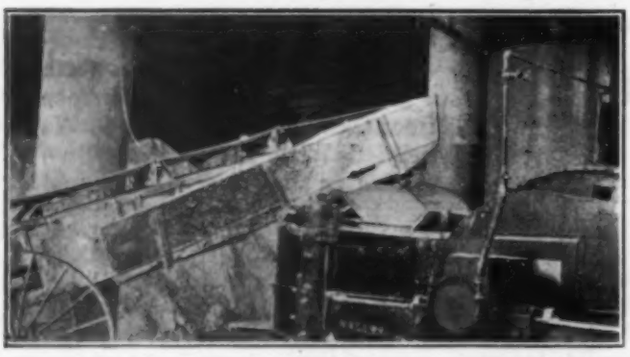


FIG. 1—BEATER FOR PREPARING CLAY SLIP

water so that the sheet is sufficiently strong to make the jump to the first press unsupported.

Felt belts carry the sheet during the rest of its journey through a series of press rolls and to the drying cylinders. The drying cylinders are covered with a glass hood which acts as a receiver for all the water vapor as it evaporates from the paper. This vapor is then removed by a powerful fan.

Reels take care of the finished paper as it comes from the machine after passing through a stack of calenders. From the reels it passes through slitters and is rewound on a rewinder as six rolls each 19½ in. wide. These form the wall paper base or hanging. About 45 tons of paper is produced per day.

An unusual feature of the mill is the continued re-use of white water—that is, the water which drains through the Fourdrinier screen carrying with it an appreciable amount of the finer fibers. This is pumped back to storage chests and is ready for use in the beaters and thus circulates continuously through the process. It is of course necessary to add sufficient fresh water to make up for that lost by evaporation in the driers. This amounts to about 75 tons per day. Such re-use of white water is made possible by the fact that no injurious chemicals are used in treating the pulp and consequently there is nothing to accumulate in the water and cause trouble.

China clay forms the base for the coating materials and the colors which are used in printing the designs on the paper. Clay is unloaded from cars on the siding directly to a storage room by means of portable belt conveyors. Another unusual feature is that in one end of the room is a regular Niagara beater in which the clay slip is formed. A charge of clay is transferred from the storage piles to the beater, the required amount of water and glue is added and a uniform slip is rapidly produced. Fig. 1 shows the conveyor in position for charging the beater, with clay storage piles in the background. This beater has replaced a whole battery of agitator tanks and is doing the work more rapidly, more satisfactorily and with less labor and attention. It will handle 5 tons of clay per hour.

For the production of the various colors, portions of aluminum hydrate base are treated in mixing tanks, Fig. 2, with suitable amounts of coal-tar dyes to produce the desired lake or shade. The lake is then filtered through a continuous filter, Fig. 3, and the pulp color is mixed in a kneading and mixing machine with the adhesive vehicle which will hold the color on the paper. Glue, various gums and starch preparations are used in making these pastes. As the pulp colors must often remain in contact with the moist pastes for some time, care must be exercised in choosing dyes and pigments which will not be affected under these conditions. Direct and acid dyes are largely used, although for certain colors inorganic pigments are employed. Some of the special inks do not contain any pulp colors, being composed of paste and such materials as bronze powders or finely ground mica. About 3½ tons of pulp color is produced per day in this department.

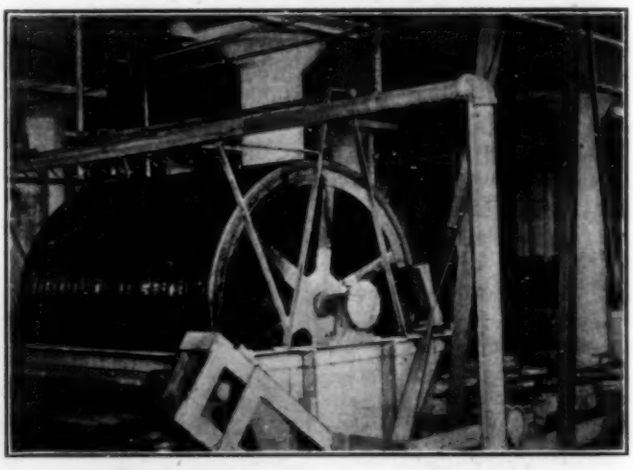


FIG. 3—CONTINUOUS FILTER FOR PULP COLORS

Since the hanging paper does not have the color or texture necessary for the background of the printed design, a coating operation precedes the printing process proper. Coating machines apply a plain ground color to the entire surface of the paper. In some cases the color is simply china clay, or the clay may be made still whiter by precipitating barium sulphate upon it, while in other cases tinted clays are used. These operations are carried out in the tanks shown in Fig. 4. From these the clay is pumped to agitator tanks, which keep the coating in suspension until it is used on the

FIG. 2—COLORED LAKES FORMED IN THESE MIXING TANKS

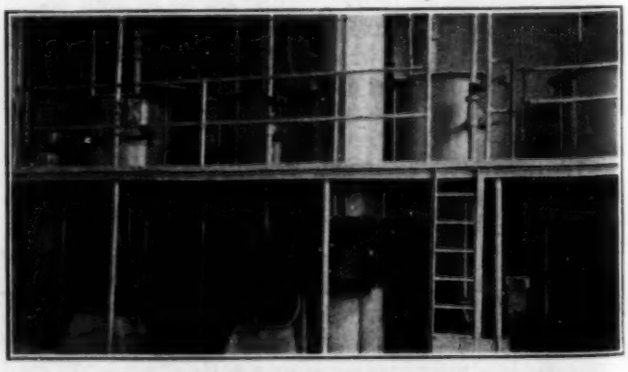


FIG. 4—TANKS FOR TREATING CLAY SLIP TO FORM VARIOUS COATINGS

coating machines. In the latter the paper runs under a roller fed with coating material by an endless belt which dips in a trough containing the clay slip. Brushes working at right angles to the line of motion of the paper distribute the coating evenly. After drying, the paper is ready for the design. The festoon driers used are similar to those which will be described in connection with the printed paper.

In general appearance, the printing machines resemble those used in textile mills. There is a great difference, however, in the printing rolls. For wall paper, these consist of maple rolls with the designs outlined in strips of sheet brass. From the original design prepared by the artist, a series of transfer patterns is made—one for each color. These are then transferred to the wooden rolls and skilled workmen proceed to cut

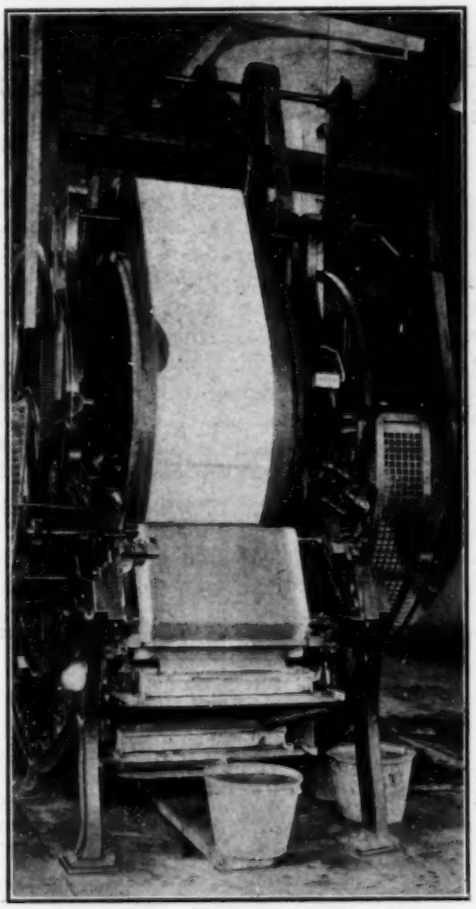


FIG. 5—PRINTING MACHINE

lengths of sheet brass strips, bend them to conform with the curves of the design and then hammer them firmly into the surface of the roll. The brass strips extend about $\frac{3}{4}$ in. beyond the surface of the roll. Where solid masses of color are required, the spaces between the strips are filled in with specially prepared felt. When the design has been completed, the surface formed by the projecting strips is ground in a lathe until uniform so that it will print evenly.

As may be well imagined from the brief outline just given, this work requires skill and unlimited patience. Imperfections in spacing are readily apparent in the finished print, so that the labor involved in the production of, say, a dotted honeycomb design is quite obvious.

All of the rolls required for a given design are mounted on the printing machine. At this mill there

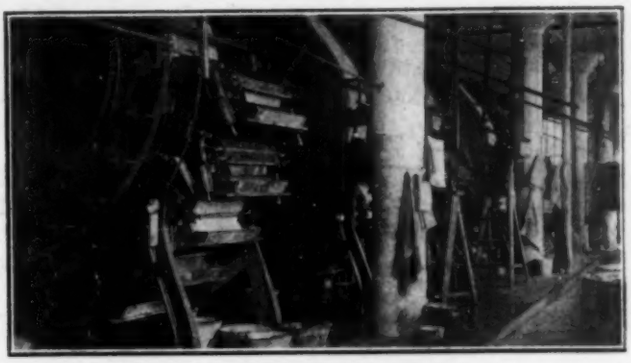


FIG. 6—BATTERY OF PRINTING MACHINES IN OPERATION

are two sets of machines, one for eight-color work, the other for twelve. Each printing roll is supplied with the appropriate color by means of a short felt band which picks up color from another roll revolving in a shallow reservoir or trough containing color. Above this roll is a blade which scrapes excess color from the felt so that just the right amount of color will be transferred to the printing roll. The paper is supported on a rubber blanket during printing in order to insure clear, perfect impressions. These details are evident in Fig. 5, and also in Fig. 6, which shows a battery of printing machines in operation.

Paper is fed to the machines from a reel just in front of which is a short belt conveyor. Several yards of paper are carried on this in the form of loose folds, giving sufficient leeway to permit change of rolls without stopping the machine. Passing through the printer, each printing roll contributes its particular color. As the paper emerges bearing the complete design, it is picked up by a series of moving spaced bars and carried in short festoons underneath a duct from which warm dry air issues. With this arrangement the annoyance of spots due to condensation in the hood is entirely eliminated. Fig. 7 is a view along one set of driers, although the individual festoons are not apparent, as they were in motion while the picture was being taken. The lower drier carries paper from the coating machine, while the printed paper is handled on the upper one.

After traveling about 85 ft. the wall paper is thoroughly dry and with some patterns this completes the manufacturing process. In others, however, subdued effects are produced by overprinting the whole design with a sort of screen, usually in white. This is done on a supplementary printing machine followed by another festoon drier. Embossed effects may also be obtained by running the paper through an embossing machine having properly surfaced rollers.

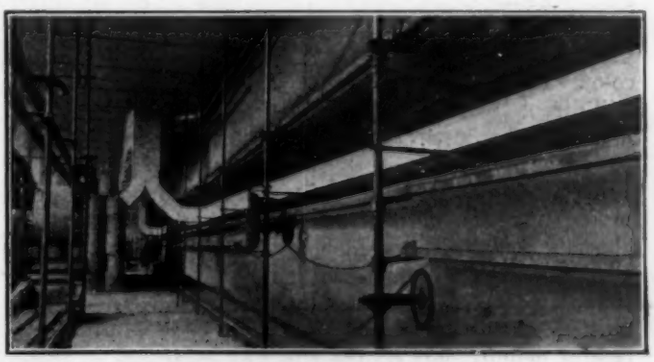


FIG. 7—VIEW ALONG FESTOON DRIERS

Special papers include the oatmeals and varnished tile. The surface of the former consists of colored or tinted stock containing comparatively fine particles of sawdust. In the latter, the design is printed from engraved rollers and the entire surface is coated with a transparent spirit varnish.

Ingenious automatic machines reel up the paper in measured 16-yard lengths, at the same time perforating the selvage edge so that it can be removed easily after the paste has been applied. This feature is fully protected by United States patent and is used only on Sears, Roebuck paper. These double rolls, as 16-yard rolls are known in the trade, are wrapped up in a very neat manner and placed in stock or shipped to the stores at Chicago, Philadelphia, Dallas and Seattle. For delivery, the rolls are packed in paper cartons. As noted previously, the mill has a capacity of about 30,000,000 rolls of wall paper per year.

In spite of the large amount of glue used, the characteristic odor so common in many mills is entirely absent. This is only one indication of the careful chemical control which is maintained by the laboratory to make certain that the proper care is exercised in the handling and treatment of all materials. Similar attention to a multitude of other details has resulted in spotless cleanliness throughout the mill. The paper machine is painted white and no rubbish is allowed to accumulate anywhere. An efficient ventilating system insures comfortable working conditions at all times. Indeed, at every point indications of efficient and understanding management are in evidence.

## Bureau of Mines Works on Explosives

Much experimental work on explosives is at present under way at the experimental station of the Bureau of Mines, at Pittsburgh, Pa. One of the most important researches is for the determination of fundamental data on the solubility, hygroscopicity, melting point and decomposition temperatures of compounds used in explosives. This information leads to the development of methods of purification and separation of materials and thereby makes the handling of explosives less hazardous. The solubility of TNT in eleven solvents has been determined and the data are ready for publication.

Small-scale tests of ammonium nitrate are being made to determine its explosibility by means of boosters only. The tests will be made at normal temperature with the ammonium nitrate at normal density and with such a degree of confinement as is found suitable from preliminary tests. The compression of small lead blocks will be used as the criterion of explosibility. The use of the following explosives as boosters is contemplated: Picric acid, tetryl, TNT, TNA, amatol 80/20, high-grade ammonium dynamite, blasting gelatine and 40 per cent ammonia dynamite. This work is being done in co-operation with the National Research Council, which will direct further work on the problem.

One of the important problems in metal mining, tunneling or quarrying is the most economical method of bringing down the ore or rock. The two factors having great influence in determining this are drilling and blasting costs. In considering the efficiency of the explosive used, the diameter of cartridge has always been supposed to play an important part. However, the attention of the Bureau of Mines has been called to the lack of definite data on the effect of cartridge diameter on the strength and sensitiveness of high explosives. This information is especially valuable to the user of explosives, as it assists him to determine what diameter of borehole is most economical. Accordingly the bureau, in co-operation with the Institute of Makers of Explosives, has conducted a series of tests to show the effect of cartridge diameter on the strength and sensitiveness of certain high explosives. The results of these tests are given in Serial 2436, by Spencer P. Howell, explosives engineer, and J. E. Crawshaw, explosives testing engineer, which may be obtained from the Bureau of Mines, Washington, D. C.

Information regarding additions, removals and changes in the permissible list of explosives from March 15 to Dec. 31, 1922, is given in Serial 2430, by S. P. Howell, explosives engineer, which has just been issued by the Bureau of Mines. The list supplements that contained in Technical Paper 307, issued in March, 1922.

## Increase in Newsprint Production in Canada

In a study made by the Canadian Pacific Railway, figures have been compiled which permit a comparison of the newsprint situation in Canada in 1922 with previous years. During the first 10 months of last year production reached 896,840 tons, an increase of 237,249 tons over the same period for 1921. As the American market depends upon Canada for approximately one-third its annual consumption, the bulk of the dominion's output comes to the United States. More than 900,000 tons was exported last year, but it has been estimated that Canada and the United States will together use 13 per cent more newsprint this year than in 1920.

Increased advertising on this continent will also result in a greater consumption of newsprint and if the demand from Oriental and European markets continues, the coming year will in all probability show the largest newsprint production in the history of the industry in Canada. A comparison of figures for a 10-year period indicates the extraordinary development of the Canadian newsprint mills. The total output in 1913 amounted to 350,000 tons. In 1921 it had advanced to 805,114 tons, an increase of 130 per cent. During the 10-year period, 1912-22, it has been estimated, there was an increase of 300 per cent in the production of newsprint.

## Sugar Refining in Bulgaria

Bulgaria has five large, well-equipped beet-sugar factories with a potential producing capacity of 50,000 metric tons of refined sugar annually, according to a recent report to the Commerce Department. National pre-war sugar consumption in Bulgaria, which ranged around 35,000 tons annually, has now declined to about 25,000 tons. Thousands of refugees have migrated into the country from Macedonia and east Thrace and the population has increased by about 500,000 over pre-war figures despite a loss of 8.5 per cent in territory. Were the factories operating at full capacity, the country would already be on an exporting basis. The director of a large sugar factory located at Sofia stated that his plant will not run at more than 20 per cent capacity this season. The beets cannot be obtained; farmers are holding out for higher prices for the raw beets and display a tendency to turn from beet raising to the culture of more remunerative crops such as tobacco. Sugar producers are of the opinion that Bulgarian domestic production during the present campaign will amount to about 15,000 tons of refined sugar; thus a surplus of 10,000 tons remains to be purchased abroad.

# Stafford Wood-Carbonization Process

## An Apparently Successful Attempt to Use Wood Scrap From Lumber Mills Outlined—All of the Valuable Byproduct Recovered

AFTER hundreds of unsuccessful attempts have been made to utilize small waste wood in the carbonization and wood-distillation industries, Prof. O. F. Stafford, a University of Oregon man, has perfected a process that is commercially successful. A superior grade of charcoal as well as the usual wood-distillation products can be obtained from mill waste under his process. So it is reported by *Science Service*.

Professor Stafford first demonstrated his process scientifically on the University of Oregon campus. He and the firm of engineers behind him have now succeeded, after several years' work, in demonstrating it as a practical commercial process. Two wood-distillation plants on the Atlantic coast, one of them controlled by a big corporation, placed every resource at Professor Stafford's disposal, and the success of the process was completely demonstrated.

By the new process a fine grade of charcoal can be obtained as well as the usual byproducts of carbonization, acetic acid, acetone and methanol, basic in the manufacture of such articles as dyes, paints, varnishes, celluloid, smokeless powder and artificial leather.

### Economical Advantage of the Process

Cord and slab wood have been the accepted material used in making charcoal and its byproducts. As small waste wood is materially cheaper than either slab or cord wood, the desirability of utilizing it in carbonization operations has long been recognized. Eight hundred applications have been made at various times at the Patent Office by those who thought they had hit upon a process of carbonizating small waste wood on a commercial scale. The failure of these efforts, until the Stafford process was proved successful, has been due, in general, to heavy costs of installing and maintaining the complicated mechanical appliances required.

In 1920, after experimental demonstrations at Cambridge, Mass., work was continued in a plant of 200 cords daily capacity at Kingsport, Tenn., which had originally been erected by the National Research Council during the war for chemical experimentation.

The commonly accepted practice of carbonization is to place cord or slab wood in large oven retorts made of steel plate. Fires in the furnaces beneath are started. Vapor outlets from the oven are provided, these outlets leading to condensers for the recovery of the liquid products of the distillation. The charcoal is withdrawn after the wood has been carbonized.

### The Stafford Carbonizing Chamber

The retort used in the Stafford method is a cylinder, 32 ft. high and 9 ft. in diameter. The cylinder is set vertically and the appliances are such that the wood to be carbonized is fed continuously into the top, while charcoal is withdrawn continuously from the bottom. A remarkable feature of the process is that no heat is applied to the cylinder after the process once is started, the carbonization of the wood being spontaneous under the conditions which the invention maintains.

In previous processes the principal difficulty encountered in the use of small waste wood has been that of transmitting heat to the interior of a mass of finely divided woody material in the retort. Such a mass is a poor conductor of heat. Only the portions of it in contact with the hot walls of the retort can in any reasonable time reach a carbonizing temperature. The numerous attempts to handle such material have had to do principally with overcoming this difficulty.

Formerly the wood used in carbonization work has always contained moisture. But Professor Stafford experimented with perfectly dry wood. He found that when the dry wood is heated under his process to the temperature at which the charring begins the carbonization went along to completion without further application of heat from outside sources. In other words, the process is exothermic.

### Cost of Installation and Upkeep Low

The cost of installing a plant under the new plan is considerably less than that of building an oven retort plant of equivalent capacity. It has other advantages, among which are low depreciation and low labor and fuel costs as compared with other systems.

It has not yet been demonstrated whether the charcoal made under the Stafford process can be used in the iron industry. The charcoal produced from small waste wood would have to be briquetted for direct use in a blast surface.

In the working out of the Stafford process in the Pacific Northwest, Douglas fir would be the most available species of wood. It occupies an intermediate position between the hardwoods and the soft or resinous wood, such as the Southern long leaf pine. Hardwoods give a high yield of wood alcohol and acetic acid, while the Southern pine gives low yields of alcohol and acid but a high yield of turpentine oils and resins.

## Magnesia as Polishing Agent

In a paper entitled "Polishing Aluminum and its Alloys for Metallographic Study," by E. H. Dix, Jr., appearing in *Chem. & Met.* for Dec. 20, 1922 (p. 1217) and presented before the February meeting of the Institute of Metals division of the A.I.M.E., it was recommended that magnesia be used as the final polishing medium. Dr. Walter Rosenhain, who originated its use, says that it is necessary for the magnesia to be kept clean and perfectly dry. It is best to try some "heavy magnesia" from several makers, rather than buying through a broker, and then place repeat orders direct with the source of a sample which will satisfactorily polish copper, gold or any soft metal. It is possible for the individual to calcine the carbonate, but not necessary to go to this trouble. Likewise, it is impossible to levigate the product after its formation.

Polishing disks must be kept vigorously clean. Each day they must be scrubbed with a hand brush and a copious amount of freshly distilled water, continuing the process for some time after the cloth appears quite clean. If the disk is not used constantly, it should be flooded with distilled water daily, and kept constantly wet.

The great advantage of magnesia as a final polisher is that a trace of it does not produce complicating reactions in the etching medium. The disadvantage is the ease with which it transforms into gritty particles of carbonate.

# Second Institute of Metals Lecture

**A Digest of Walter Rosenhain's Address Upon Atomic Arrangement in Solid Solutions, and How This Will Affect Such Phenomena as Melting Range, Hardness, Diffusion and Intermetallic Compounds**

HAVING been asked to give an address on some theoretical aspect of metallurgy, Dr. Rosenhain chose to propose a new theory on the nature of solid solutions. Even though there is no quantitative proof of each step of its development, there is a body of experimental evidence in support of the main theory, and logical conclusions drawn from it are in striking accord with well-known facts. While solid solutions are by no means confined to alloys, they have been studied most extensively by metallurgists; consequently it appeared best to confine attention to intermetallic solid solutions.

### Solidification of Solid Solutions

The term "solid solution" is paradoxical to the uninitiated, involving a contradiction of terms. What it connotes is approximately "a crystalline body formed either from a liquid solution or from an intimate mixture of solids, or from both, which retains in the solid state an admixture of the two substances (solvent and solute) as intimate as that which exists in a liquid solution." Equilibrium diagrams of many binary alloy systems show areas where solid solutions are stable—theoretically it seems that complete insolubility is impossible. From typical diagrams, the lecturer reviewed the well-known facts shown on Fig. 1 that a liquid of composition *x* (e.g., 75 per cent *A*, 25 per cent *B*), upon cooling will commence solidifying when the temperature reaches *c*, but the solid separating is of a composition shown by *d* on the solidus curve. As the solid is rich in *B*, it impoverishes the liquid in that element, thus requiring a further cooling before more of it will freeze. If cooling be at a very slow rate, the demands of equilibrium will be met, and the solidified portion also gives up part of its excess of *B* to its surroundings as it cools. Thus at any temperature during the mushy range the composition of the liquid is represented by a point *e* on curve *L* and that of the solid by the corresponding point *f* on curve *S*. Finally the last trace of liquid (rich in *A*) solidifies, and its excess of *A* will diffuse into the solid, which finally cools as a homogeneous solution of composition *g* (75 per cent *A*, 25 per cent *B*). The same mechanism is followed during solidification of alloys of the type shown in Fig. 2, having only a limited mutual solubility in the solid.

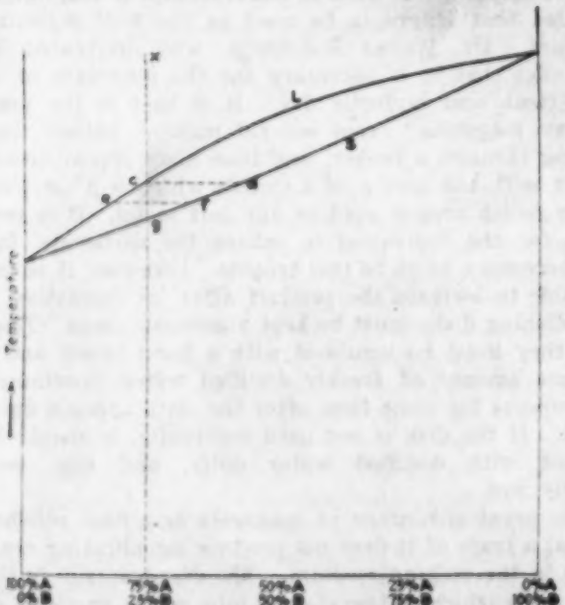



FIG. 1—EQUILIBRIUM DIAGRAM OF BINARY SYSTEM COMPLETELY SOLUBLE IN BOTH LIQUID AND SOLID STATE

Consideration of Fig. 2 indicates that the temperature of melting falls with increasing concentration of solute in the solid solution—that is to say, less energy needs be imparted to a solid alloy to disrupt the atoms sufficiently to transform them into the liquid state. If it be granted that this family of alloys requires a fixed total of energy to induce the mobility of the liquid state, it follows that a store of energy must be held in the crystals of solid solution—that is, the material is "self-strained" with potentially disruptive energy. The limit of solubility in the solid would therefore be determined by the maximum amount of such energy which could be stored in the internal structure of the crystal. The latter conclusion is also reached by elementary thermodynamical considerations even though it is demanded by this theory that a solid solution must occur because it constitutes an atomic arrangement which contains the least amount of stored energy. Solid solutions will continue to form with increasing amounts of solute, until a composition is reached where the energy content of the more highly saturated solid solution would be greater than that inherent to a duplex structure. This implies that increasing concentration of the solid solution brings with it an increasing storage of internal energy until the limit is reached.

### Energy Stored in Strained Crystals

How can this energy be stored within the crystals? Here is where the X-ray diffraction patterns give the greatest help.

Readers of *Chem. & Met.* will remember the recent articles by Bain[1] and Jeffries and Archer[2] on this method of investigation. For the sake of continuity it need only be said that if a beam of monochromatic X-Rays be projected through an aggregate of fine crystals, it will be diffracted in a definite series of directions. The diffracted rays, falling on a photographic film, will develop a series of lines or bands whose mutual spacing will depend upon the geometry of the internal structure of the crystal and the distances of the atoms, each to each.

[1] "Studies of Crystal Structure With X-Rays," vol. 25, p. 657 (Oct. 5, 1921).

[2] "Crystalline Structure of Metals," vol. 24, p. 771 (May 4, 1921).

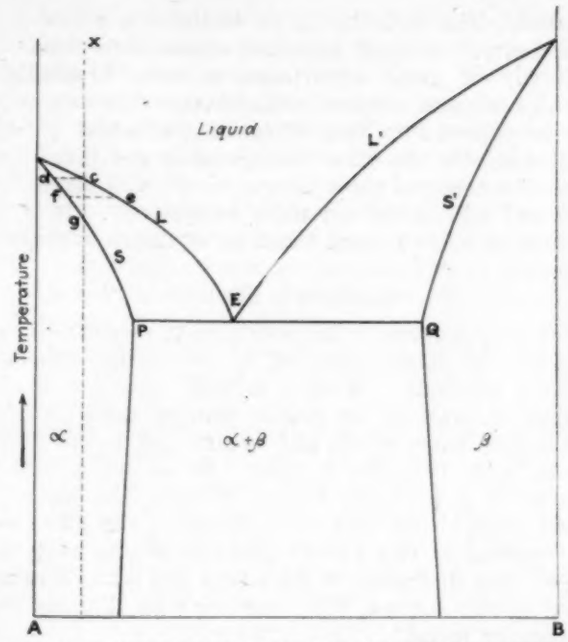



FIG. 2—EQUILIBRIUM DIAGRAM OF BINARY SYSTEM PARTIALLY SOLUBLE IN SOLID

Such studies have revealed the fact that most metals crystallize in relatively simple cubic lattices of varying dimensions. More complex lattices are possessed by brittle metals like zinc, bismuth and antimony, by the compound $Fe_3C$ (cementite), and are to be anticipated in intermetallic compounds.

## Essential Structure of Metallic Crystal

We must think, then, of a metallic crystal as built of atoms fixed upon an imaginary framework. The atoms move about their equilibrium position by thermal agitation, but the average distance atom to atom is definitely governed by the forces exerted by its surroundings and which hold it to its mean position in the space lattice. Heating the metal increases the thermal agitation and expands the lattice; when this expansion is carried beyond a certain limiting amount it seems to break the interatomic linkage, and the crystal melts. If the lattice is extended by mechanical means, the new phase formed is Beilby's amorphous metal.

It should furthermore be remembered that it is probable that the atom is a complex structure in itself consisting of a nucleus and an outer system of electrons. It occupies and dominates completely the space determined by the radius to the outer electron shell; and the dimensions of the space lattice are such that the atom volumes so defined almost or quite touch one another. (That is to say, there is no insterstitial space comparable in dimensions with the space occupied by any single atom.) Still the outer electrons or their orbits must be deflected not only by mutual interactions with their neighbors, but also by the application of external stress. Whatever, therefore, tends to change the space lattice also distorts the atoms or at least deranges their outer electrons.

Pure metals, we are assured, possess lattices of great regularity, but solid solutions must be more complex, since they contain many "stranger" atoms (solvent) among those of the host (solute). It is known that such solutions are still crystalline; for instance, alpha brass readily forms twins. X-ray analysis of a solid solution shows also a well-defined space lattice, ordinarily differing only slightly in dimensions from that of the solvent metal.[3]

Do the stranger atoms replace their hosts in their regular positions, or do they find their way into voids? The latter possibility is unlikely, except in very special cases, because there is small room left in a close-packed lattice, and insertion of a stranger atom would distort the lattice beyond the limits of endurance, and second it would demand that solubility be inversely proportional to atomic volumes—a condition which experiment shows does not exist. The alternative supposition—which might be called a "substitution" theory—has been verified by X-ray work in Dr. Rosenhain's laboratory by Messrs. Owen and Preston [and in this country by Dr. Bain]. It also leads to a general view of the atomic structure of solids which explains a wide range of known facts, and should ultimately lead to quantitative verification and even predictions.

## Stranger Atoms Substituted for Hosts

Substitution of a stranger atom for an atom of solvent in the space lattice must profoundly affect the entire lattice in that vicinity. Fig. 3 shows the simplest case of the arrangement of atoms along any principal plane in a cubic lattice. Now, replace the center atom with another, Fig. 4. Suppose further that the natural space lattice of the latter, when pure, is larger in

[3] "Nature of Solid Solutions," by Edgar C. Bain, *Chem. & Met.*, vol. 28, p. 21 (Jan. 3, 1923). "Cored Crystals and Metallic Compounds," by Edgar C. Bain, *Chem. & Met.*, vol. 28, p. 63 (Jan. 16, 1923).

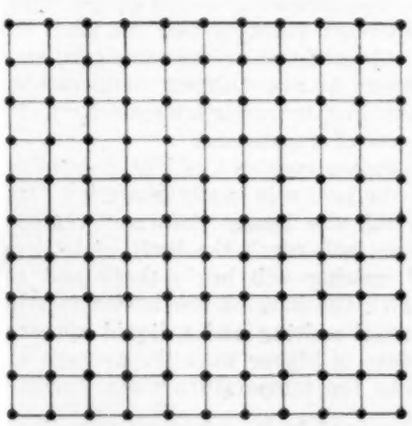


Fig. 3—Spacing of atoms on principal plane of cubic lattice

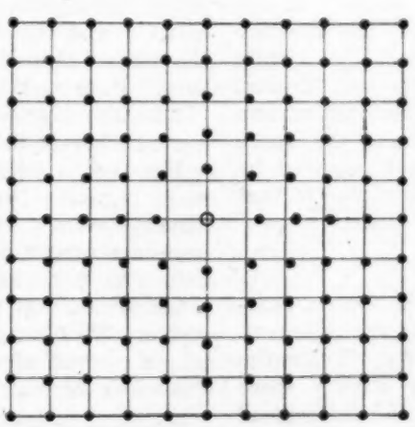


Fig. 4—Distortion in ductile lattice due to large stranger atom

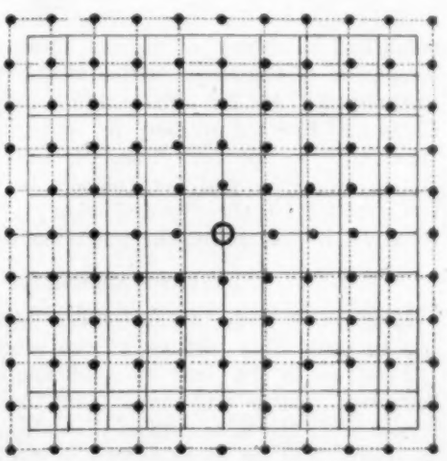


Fig. 5—Distortion in stiff lattice due to large stranger atom

dimension. This would probably mean that the forces between solute atom and the surroundings would be less than those between solvent atoms themselves, and several layers of the latter would shift outward an ever-decreasing amount to balance this lessened attraction. It is apparent that a considerable amount of material is affected. For instance, assume a cube corner to be the center of a disturbance reaching five atoms deep; then a concentration of only one atom in 8,000 would be sufficient to affect the entire mass, bringing about not only a series of local intense distortions but also a slight general expansion of the entire lattice. The relative amount of local and general distortion evidently depends upon the character of the solvent metal itself—a "stiff" lattice might act about as shown in Fig. 5. The first case might be likened to some peas scattered about between the layers of a pile of rubber sheets; the second, to pebbles between tin plates.

It might be argued that the same effect would be

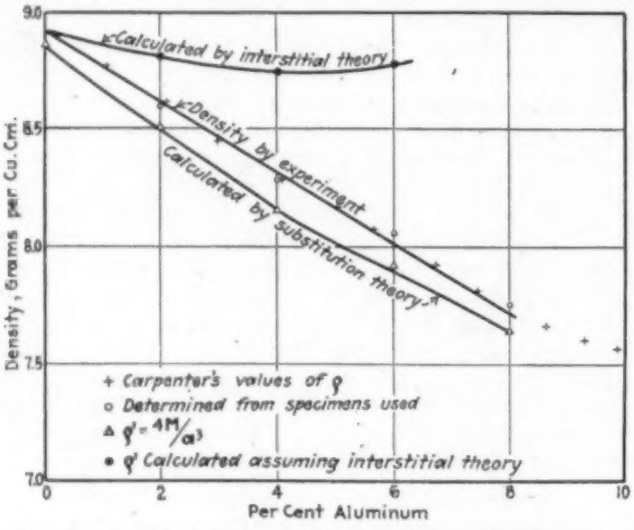



FIG. 6—RELATIONS BETWEEN SPECIFIC GRAVITY AND LATTICE SIZE IN ALUMINUM-COPPER ALLOYS

produced if stranger atoms were inserted between atoms of solute. A clear distinction may be drawn by specific gravity measurements. It is known that densities of solid solutions check closely the values computed from the density of the constituent metals and proportions present. Now if the solute atoms were pushed in small voids, the space lattice would need to be enlarged a great deal in order to compensate for the additional density due to the interpolated solute atoms. If the substitution theory is correct, however, the average dimension of the space lattice would remain practically unchanged. At Dr. Rosenhain's suggestion, Messrs. Owen and Preston studied the copper-aluminum system from this standpoint (Fig. 6) and found the space lattice to correspond very closely to that required by the substitution theory,[4] and widely at variance to that required by assuming the insertion of atoms.

### Limit of Solubility

Many interesting inferences can now be drawn, bearing in mind this picture of the atomic arrangement.

First, as to the limit of solid solubility. Evidently, "similar" atoms will enter into each other's space lattice with the minimum of distortion, and the mutual solubility will be large before unstable conditions are reached. The difficulty is to establish a criterion of "similarity." Crystal form and atomic dimensions are naturally of great importance—a metal crystallizing in the cubic and another in the hexagonal system would not be expected to form a continuous series of solid solutions. On the other hand, copper and nickel both form face-centered cubic arrangements with dimensions 3.60 and 3.54 Angstrom units respectively. It is not surprising to find them build an equilibrium diagram like Fig. 1.

### Hardening Effect

Second, hardness or the resistance to plastic deformation will be largely affected by the lattice distortion in solid solutions.[5] When a metallic crystal is loaded, it first deforms in an elastic manner until its limit is reached, after which slip occurs and layers of the crystal slide over one another. Such sliding will be easiest in a perfectly regular lattice; the layers of atoms lying on the two sides of such a slip plane may be regarded as two smooth surfaces sliding over each other. Any distortion of the lattice will act as a roughening of this surface, will interfere with slip, and thus harden the metal.[6]

Here are two measurable properties—viz., limit of solid solubility and hardening—which appear to depend upon disturbance of the lattice. Theoretically, the greater the range of solid solutions formed the less should be the hardening effect of the added metal per atom added. What are the actual relationships observed?

To quote only the well-known solutions of copper, the specific hardening effect ranks in the following manner, from least to greatest: Ni, Mn, Zn, Al, Sn. The limit of solid solubility for the respective alloys is 100 per cent, 100, 36, 14, 6.7.

### Mechanism of Melting Over a Range

Other even more typical properties of solid solutions may be explained from the standpoint of a distorted space lattice—namely, the occurrences during solidification (or their reverse during melting) summarized in Figs. 1 or 2.

First, consider a crystal of pure metal as it is heated. Increasing thermal agitation of the atoms merely expands the lattice. Thus, Westgren has measured the lattices of iron at various temperatures, and finds they agree with values calculated from the thermal expansion of a bar. As already argued, this expansion cannot exceed a certain value without the appearance of a new phase (an allotropic transformation occurs or the metal melts); and the important point is that all parts of the lattice reach this breakdown at the same temperature. Pure metal melts at one uniform temperature. (It is also significant that refractory metals have, in general, low coefficients of expansion.)

However, a solid solution such as α of Fig. 2 contains many regions where the lattice is locally distended. On heating such a crystal, the locally deformed regions around stranger atoms will reach the limit of lattice-extension first, and melting will begin there and at a temperature at which the bulk of the lattice is still stable. We have partial melting and a liquid appears whose content of solute is higher than the average of the whole crystal. As the temperature rises, further

[4] Bain in this country has verified this fact for several other series of solid solutions. See footnote 3.

[5] "Hardness of Solid Solutions," by W. Rosenhain; *Proc. Royal Soc. London*, A, vol. 99, p. 192; *Chem. & Met.*, vol. 25, p. 243 (Aug. 10, 1921).

[6] "Slip Interference Theory of Hardening," by Zay Jeffries and R. S. Archer, *Chem. & Met.*, vol. 24, p. 1057 (June 15, 1921).

regions of less distorted lattice will melt, diluting the liquid solution, and finally the mushy range is passed and the whole crystal has melted. This will occur at less than the temperature required by pure solvent because the entire lattice is deformed and reaches its limiting extension after a smaller amount of thermal expansion.

On the basis of the substitution theory, the solidus (line *S* of Figs. 1 and 2), or beginning of melting, depends upon the maximum local extension in the lattice caused by stranger atoms, while the liquidus (line *L*), or end of melting, depends essentially upon the general extension of the lattice. If local distortion is large and general extension small, the solidus should have a steeper slope than the liquidus, and will be steeper the lower the solid solubility of the stranger atoms. This is generally confirmed. Long ranges of solid solutions give narrow mushy ranges; low solubilities are associated with nearly vertical solidus lines. It may also be inferred that slight local distortions but the general extensions of Fig. 5 are more likely to occur in the rigid lattices of harder and stronger metals of high melting points. This connects strength, hardness, high melting point and ability to form long ranges of solid solutions (e.g., Fe, Ni, Co, Cr, Cu, Ag, Au). On the other hand, soft, low melting metals (Pb, Sn, Cd,) approach the wholly eutectiferous type of diagrams.

While the above argument has been based on expansions of the lattice by stranger atoms, it may be applied *mutatis mutandis* if the solvent lattice is compressed. Then the melting point of the alloy should be higher than that of pure metal (Fig. 1). For instance, alloying nickel (2.50 A.u.) to copper (2.54 A.u.) will compress the lattice of the latter and raise the melting point. The equilibrium diagram shows that even near the copper end of the series the portions first to solidify have a higher nickel content than the liquid from which they form. The silver-palladium system is another striking confirmation of the above facts.

## Diffusion

Although the equilibrium diagrams (Figs. 1 and 2) show that the solidified alloys *x* should have a homogeneous structure, it always occurs that equalization between the first solidified parts and the last remaining mother liquor is never attained during cooling. A cast alloy always shows "cored" crystals. This apparent duplex structure may be obliterated, however, and replaced by the uniform appearance characteristic of pure metal by a suitable annealing far below the melting point.

Bearing in mind that this is done without anything like recrystallization of the alloy,[1] we may ask, By what mechanism does this redistribution of solute atoms occur? Since a space lattice is approximately filled by its constituent atoms, can it open up to allow passage for migrating atoms?

Dr. Rosenhain thinks this may be explained by the phenomenon of intercrystalline slip. As temperature rises, the force necessary to produce slip decreases rapidly. Furthermore, it requires less force to slip a single crystal than an aggregate, where each is supported on all sides by its neighbors. He believes, therefore, that intense local forces set up in the immediate neighborhood of stranger atoms will cause slight slips, probably of only a few atom-diameters distance, rather than the 2,000 or more caused by plastic deformation, and probably only a row or single line of atoms move, rather than a whole layer. If the distribution of the stranger atoms is not uniform, there will be a tendency to slip in a direction leading toward the region of low concentration. Slips of one step at a time, taking place at intervals in the various principal planes of the lattice, will be sufficient to account completely for diffusion—it is obviously possible by a suitable number of successive slips of this nature to carry a solute atom from any one position in the lattice to any other.

Under these conditions, what happens to the atom at the end of the row when slip occurs? It probably passes into the more or less non-crystalline or amorphous layer present at the boundary, while at the other end of the row room is made for the entry of an atom passing into the lattice from the intercrystalline layer. Other considerations lead us to suppose that an interchange of matter constantly occurs at high temperatures between crystals and their boundary layers.

Dr. Rosenhain observed that to test these assumptions about diffusion will be difficult. It would be expected that the atoms which distort the lattice most would cause the most of this extremely local slipping and diffuse fastest. However, we have no experimental data on rates of diffusion. In a qualitative way, however, the extremely sluggish diffusion in copper-nickel alloys has been noted, and in this we have seen that the lattice distortion is very slight. Carbon also diffuses in gamma-iron very rapidly, although its solubility is relatively low. On the other hand, phosphorus diffuses very slowly in iron, its solubility is low, and it has a pronounced hardening effect—i.e., distorts the lattice materially.

## Intermetallic Compounds

It is only a step from solid solutions to intermetallic compounds. If the latter be defined as homogeneous crystalline alloys between two metals in such a ratio as to conform to the law of multiple proportions, it would be impossible to distinguish them from solid solutions. Intermetallic compounds, however, have definite characteristics, and are located on the equilibrium diagrams in special ways. Likewise, a definite X-ray spectrum has been found for the compound $CuAl_2$—it is very complex and quite different from either pure copper or aluminum. Doubtless in it, like in some salts which have been studied, the copper and aluminum each builds up its own special lattice, and the two interpenetrate in some way which results in low symmetry.

Since the "substitution" theory of the constitution of solid solutions calls for but a single lattice—that of the solvent metal—here at once is the distinguishing criterion between solutions and compounds. The complex lattice of intermetallic compounds reflects their most striking property—their hardness and brittleness—and explains it in no way in which a consideration of the properties of their ductile constituents would suggest.

Can such complex lattices as intermetallic compounds go into solid solution as such—i.e., in molecular association? It seems obvious that it is impossible. A molecule of $CuAl_2$ is altogether too large to find room upon the space lattice of aluminum. Furthermore, if it could, it would then exhibit its typical X-ray spectrum; and this has not been discovered even in a 96:4 Al:Cu alloy. It follows that the compound does not exist until

[1] Small boundary changes occur during first cooling of the alloy, and mark out areas ordinarily independent of the dendritic structure.

it comes into existence as a separate crystalline phase—it must dissociate to go into solution.

On the other hand, it appears possible for an intermetallic compound *AB* to dissolve metal *A*, by replacing certain of the atoms *B* on its lattice by new *A* atoms, or *vice versa*. Undoubtedly in such cases interatomic bonds play a great part, and it would not be well to speculate until more facts are at hand.

### Hardening Theory

There remains one most important consideration—the variation of solid solubility with temperature. That such changes are of the greatest importance to the hardening phenomena has only been recently recognized.

Dr. Rosenhain thinks that the thermal expansion of the two metals concerned should be decisive. Assume a solvent *A* containing a solute *B*, a smaller atom but having a greater rate of expansion than *A*. Then the two should become increasingly similar and more soluble with increasing temperature. However, other factors undoubtedly have influence. It does not seem wholly justifiable to suppose that the thermal expansion of isolated atoms of *B* would be the same as a crystal of *B*. Again, increasing temperature probably changes the atom in other ways than in merely increasing its lattice spacing. Its interatomic bonds, its mobility, its volume may be appreciably changed. Certainly such changes occur in some metals abruptly and profoundly at allotropic transformations. A change in "stiffness" of the solvent lattice with changing temperature is also a factor, since it affects the energy content of the solid solution for a given concentration of solute. It is apparent, therefore, that here again is a matter which must be investigated from many angles before it can be reduced to a quantitative equation.

In conclusion, the lecturer pointed out that a study of atomic lattices and their distortions by stranger atoms would be the first step toward a quantitative metallurgy—where the hardness, limit of solid solubility, rate of diffusion, melting range and brittleness could be computed. In this way, the X-ray may draw a key map to what is now an unchartable wilderness of facts.

## Wood Distillation Products in 1921 and 1922

In *Chem. & Met.* for Dec. 27, 1922, there was published a preliminary report of the Bureau of Census on the production of wood distillation products in 1921. In checking over these figures, the Secretary of the National Wood Chemical Association of Bradford, Pa., discovered that the Census Bureau had made an error in reporting the crude methanol production, which according to the estimate of the association was at least 3,000,000 gal. higher than it should be and entirely out of line with the production of acetate of lime. The other figures appear to have been reported more accurately.

The attention of the Census Bureau was called to this apparent discrepancy and that department immediately reviewed the report of the manufacturers of wood-distillation production and the detailed statistics of production for 1921. The revised figures are given in the following table for those products which were incorrectly reported in the previous article.

The Census Bureau's report points out that the output of acetate of lime was relatively small due to the fact that, as some of the manufacturers explained, there was no market for this product and it was found to be much cheaper to use the crude liquor rather than manufacture it in acetate of lime.

| | 1921 | 1919 | 1914 |
|---|---|---|---|
| Products, total value | $9,258,500 | *$32,625,300 | *$10,529,800 |
| Methanol: | | | |
| Crude, gal. | 3,964,400 | 9,104,000 | 9,602,400 |
| For sale— | | | |
| Gallons | 3,289,300 | 6,980,700 | 7,197,000 |
| Value | $1,110,600 | $5,593,500 | $1,605,900 |
| Made and consumed, gal. | 675,100 | 2,123,300 | 2,405,400 |
| Refined, gallons | 2,831,700 | 7,391,000 | 6,465,000 |
| For sale— | | | |
| Gallons | 2,715,300 | 6,984,700 | 6,235,100 |
| Value | $1,924,400 | $8,381,900 | $2,709,400 |
| Made and consumed, gal. | 116,400 | 406,300 | 229,900 |
| Acetate of lime, lb. | 61,316,300 | 168,956,000 | 166,085,000 |
| For sale— | | | |
| Pounds | 55,448,900 | 153,910,000 | 163,522,000 |
| Value | $737,000 | $2,682,200 | $2,138,900 |
| Made and consumed, lb. | 5,867,400 | 15,046,000 | 2,563,000 |

* Includes byproducts from other industries to the amount of $79,991.

### 1922 Output Doubles

According to a more recent report of the Bureau of the Census, the production of acetate of lime and methanol almost doubled in 1922 as compared with 1921. The total output of firms which produced over 97 per cent of the total acetate of lime in 1921 amounted to 119,911,000 lb., while the methanol production was reported to be 6,687,845 gal. in 1922. The following table shows the monthly production figures as reported by firms with a daily capacity of 4,500 cords (or pro-rated to that capacity in months where some reports were lacking). These were taken from the "Survey of Current Business," published by the Department of Commerce:

| | Production | |
|---|---|---|
| | Acetate of Lime, Lb. | Methanol, Gal. |
| Months, 1922— | | |
| January | 8,330,000 | 468,818 |
| February | 7,993,000 | 457,656 |
| March | 9,660,000 | 534,812 |
| April | 7,390,000 | 416,112 |
| May | 7,064,000 | 404,847 |
| June | 7,495,000 | 441,149 |
| July | 8,718,000 | 475,376 |
| August | 9,253,000 | 508,644 |
| September | 9,537,000 | 537,803 |
| October | 12,217,000 | 664,933 |
| November | 15,440,000 | 853,687 |
| December | 16,814,000 | 942,008 |
| Total | 119,911,000 | 6,687,845 |

## Trend of World Production and Consumption of Sugar

Cuba's ability in 1922 to distribute both a record crop and a record carryover can be attributed mainly to a record consumption in the United States and to a European crop that fell far short of the consumption needs of that continent. Cuba exported more than 4,000,000 tons to the United States, approximately 850,000 tons of which (in terms of raw sugar) went to Europe after refining. Altogether, Europe was supplied with 1,700,000 tons toward her deficit of 2,300,000 tons, most of the remainder coming from Java. Approximately 3,000,000 tons of Cuban sugar remained in this country and, combined with the production of the United States and its possessions, supplied the record American consumption of nearly 5,500,000 tons (raw sugar).

Another 4,000,000-ton crop from Cuba is predicted for 1923. Encouraging reports also come from Java and a greatly increased production in Europe is expected. It is estimated, however, that various decreases elsewhere, in the United States in particular, will result in a crop only 125,000 tons greater than last year, which must supply the world consumption of sugar, calculated as 350,000 tons more than in 1922 and 725,000 tons larger than the total production.

# An Untrodden Field in Lime Research

## An Introduction to the Work Which Must Be Done on the Relation of Lime to Its Limestone Source

By Oliver Bowles
Mineral Technologist, U. S. Bureau of Mines

WIDE research has been conducted in factory and laboratory to determine the physical and chemical properties of lime in their relation to utilization for various purposes. It is now generally recognized that limes differ greatly in their physical properties and chemical activities, such as plasticity, rate of slaking, or rate of settling as milk of lime; but it is not so generally known that these variations often bear no relation to the chemical composition of the original limestone. Limestones of identical composition may, under the same burning conditions, give limes that vary greatly in character. A definite relationship undoubtedly exists between the character of the lime and the physical properties of the parent limestone, but little serious effort has yet been made to correlate them.

### The Pioneer Woman

In attributing honor where honor is due it is a noteworthy fact that to a woman must be given credit for the only important practical work that has yet been accomplished in this line of investigation. Miss Mary E. Squire, president of the Allwood Lime Co., Manitowoc, Wis., spent 4 years of investigational work, and finally identified and isolated a particular limestone bed from which is manufactured a lime that commands a price as high as $200 a ton, because it fulfills the most stringent requirements of lime for processes of extreme refinement. Possibly other work of a like nature has been done, but if so it has received little publicity.

The importance of the problem has been brought to the attention of the Bureau of Mines from two other sources, one a lime producer and one a consumer. A prominent lime manufacturer is sufficiently aroused to the significance of the relation between finished lime and the physical properties of limestone that he has expressed a willingness to engage the services of a geological chemist to make a detailed microscopic study of the various formations in his quarry, together with a study of the limes produced. A specialist employed by one of the largest consumers of lime in the United States has written to the Bureau of Mines requesting information on this same subject. Such faint glimmerings betoken the approaching dawn of an active inquiry.

What are the controlling factors—the nature of the original organisms that provided the shells from which the stone was formed; the origin, whether chemically precipitated or fragmental; the degree of cementation or recrystallization; the grain size, grain shape or some other characteristic?

The problem undoubtedly has a direct bearing on quarry processes and on lime utilization, fields in which the Bureau of Mines is enlarging its activities; but so much remains to be done that pioneer work of varying character could be profitably undertaken by several agencies. The field is open; who will supplement our present meager information?

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# Refined Tar for Coating Cast-Iron Pipe and Fittings*

## Discussion of Properties of Tar and Methods of Application to Obtain Satisfactory Coatings of Foundry Products

By S. R. Church
Technical Adviser, The Barrett Co., New York City

TEN years ago I first gave some attention to the question whether or not there ought to be a specification for a refined tar product for coating cast-iron pipe and fittings. I found that at practically all the foundries crude coal tar was being used. The method of coating varied somewhat, but was usually developed by experience and not marked by close control. I came to the conclusion that the coating could probably be improved by: (1) Closer temerature control of both castings and bath; (2) adoption of some method for testing the consistency of the coating from time to time and keeping it uniform; (3) specifications for the coating that would insure reasonably uniform consistency and freedom from excess water. It did not seem to me at that time that the last-named requirement was of greater importance than the two others.

The tars first used for coating pipe were horizontal gas-works coal tars. In the early days of gas making fireclay retorts were used and the first important change in the character of coal tar occurred when fireclay was replaced by silica retorts. With the latter, higher heats were employed and tar was produced of very high viscosity and high free carbon content.

### Water-Gas Tars Less Desirable

The newer types of tar—coke-oven, vertical-retort and water-gas—are thinner and of lower free carbon content than the horizontal gas-works tars. Undoubtedly the best coating is not obtained when very thin tar is used. Crude water-gas tar or crude vertical-retort tar makes a very poor coating, lacking body. To obtain a coating having the consistency and covering power of a medium gas-works coal tar, most of the tars now available must be modified by distillation, or reduced to the proper consistency. Either coal-tar or water-gas tar may be reduced to any desired consistency, but it is doubtful whether water-gas tar should be used for pipe coating, as its resistance to chemical attack and its life under conditions of service have not been well established.

What happens when a hot casting is dipped in tar? The object of the process is to obtain a thin but complete coating that will dry in a short time, adhere strongly to the pipe, be resistant to abrasion and finally protect the metal from corrosion. If crude tar is used, the heat is sufficient to drive off enough of the more volatile oils so that the remaining film or coating is pitch. If pitch is used to start with, either higher temperatures must be employed or a thicker coating will result. I do not believe there is any merit in a thicker coating *per se*; on the other hand, a very thin tar may produce a coating so thin as to be non-protective and unduly brittle. I am inclined to the opinion that what is needed is a refined—distilled—tar with reasonable limits as to viscosity and free carbon. The viscosity limits should be specified at an elevated temperature, say 100 deg. C., approaching that of the bath.

*Extracts from a paper read before the New England Water Works Association.

# Evaporation by Compression

**Description of the Process Now in Operation in Several Important Industrial Plants in Europe, Where It Has Proved a Valuable Factor in Heat Economy—Also a Close Study of the Heat Consumption Usually Calculated in the Sugar Industry**

BY PROF. DR. WILHELM GENSECKE
By the courtesy of Dr. Frank Mueller, who was associated with Dr. Gensecke in the operation of the experimental plant described.

A GREAT DEAL has recently been written concerning the possibilities of applying steam compression in evaporation, so the principles of the process are undoubtedly known in technical circles. It is important to note that the purpose and function of the compressor are not to generate the heat required for the evaporation, but to raise a sufficient quantity of heat to a higher temperature level; therefore, it is aptly called the "heat pump."

The operation of multiple-effect evaporators is an example, familiar to everyone, of how a quantity of heat introduced into the process can be re-utilized.

A comparison of the thermal economy of multiple-effect evaporation and evaporation by compression must be based on the assumption that the energy necessary for the evaporation by compression has to be generated by steam power, every horsepower involving a definite steam consumption depending on the thermal efficiency of the power plant. On this basis the multiple arrangement is theoretically the better one. The exchange of a certain amount of heat in a surface apparatus presupposes (given a known coefficient of heat and a known heating surface) a certain drop of temperature, which theoretically is the same, regardless of the evaporation process used. Assuming the selected apparatus to be "heat tight," and ignoring any losses by radiation; assuming further that the required heat transfer demands a temperature drop of, say, 10 deg. C., it is not difficult to calculate what amount of evaporation 1 kg. of steam can produce. Only the total temperature drop available for the process need be known. This temperature drop is determined on the one hand by the temperature of the saturated steam of the boiler, and on the other hand by the temperature of condensation, which in its turn is determined by the cooling water of the condenser connected with the last evaporator. If the boiler pressure is 16 atmospheres absolute and the temperature of the saturated steam at that pressure is 200 deg. C., the vacuum of the condenser 92.5 per cent and the temperature of condensation at this vacuum 40 deg. C., the whole available temperature drop is 160 deg. C. and a sixteen-fold evaporation is obtained with 10 deg. C. temperature drop in each evaporator; that is to say, 16 kg. of water can be evaporated in the evaporation plant by means of 1 kg. steam. The plant works with a sixteen-fold effect, and consequently has sixteen evaporator stages.

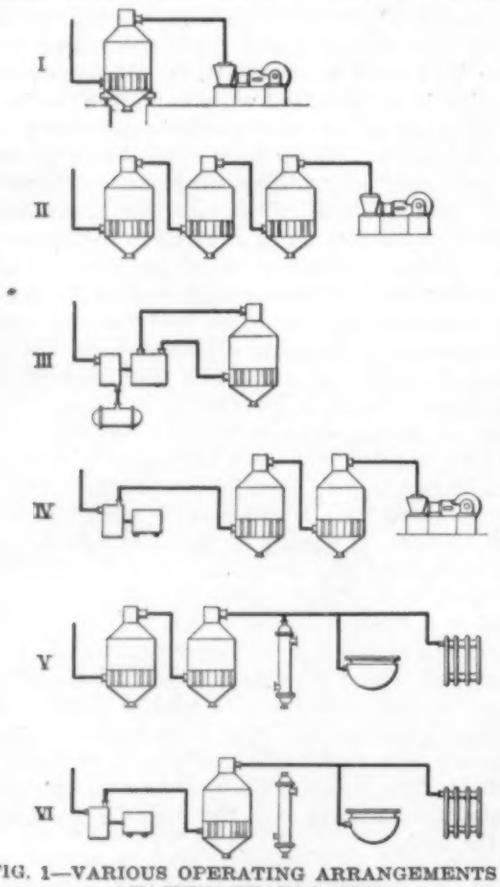



FIG. 1—VARIOUS OPERATING ARRANGEMENTS OF VACUUM EVAPORATORS

The relation thus obtained is a good approximation. In a more accurate examination of this relationship, one must take into account the dependence of the heat content on the temperature.

## OPERATION OF COMPRESSION PLANT

How does a compression evaporation plant function under the same conditions? The heating surfaces of all sixteen stages function at the same temperature. They may be imagined as being united in one large heating body. The temperature drop of 10 deg. C. is created by the heat pump, and the amount of energy required is then the same as that required for the running of the compressor. If the compressor and also the driving engine could be run without any losses, 1 kg. of steam in the driving engine would transmit 1 kg. of steam to the compressor, provided a temperature drop of 10 deg. C. (the same as is available for the compressor) were available for the steam of the driving engine. Actually, however, the same drop is available for the driving engine as that which is available for the multiple-effect evaporator—viz., 160 deg. C. Consequently, the result would be the same as with the multiple-effect evaporator—that is, a sixteen-fold evaporation. This relation also is an approximation, as the energy produced by the adiabatic expansion over a certain temperature drop is not exactly equal to the energy requirement of adiabatic compression at the same temperature drop.

As is well known, saturated steam becomes wet when

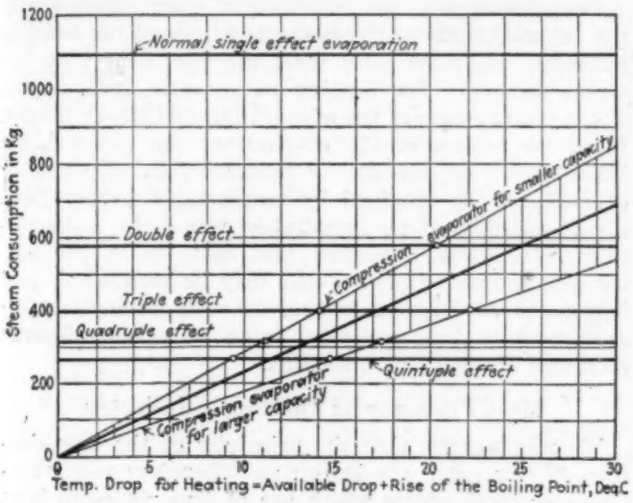



FIG. 2—THERMAL EFFICIENCY OF VARIOUS VACUUM EVAPORATORS

expanded, and superheated when compressed. Consequently, the energy gained during expansion is somewhat less than the energy required for compression, assuming the steam to be saturated at the beginning in both cases.

These are conditions which would govern systems operating without loss. Under actual conditions, it must be remembered that compressors suitable for evaporation operate with an efficiency of 65 per cent, and the same is the case with the driving engine. By multiplying the efficiencies, a resulting efficiency of 0.42 is obtained—that is to say, the compression evaporation plant allows an efficiency of 42 per cent of that of a multiple-effect evaporator. The objection could be raised that in the case of compression evaporation, the heat value of the compressor losses becomes available for the evaporation process. This, however, is inconsiderable in practice, as this work loss of the machine is covered by a thermal efficiency which in most cases is less than 20 per cent.

As far as is known, multiple-effect evaporators with sixteen stages have never been constructed. However, seven or eight stages are sufficient to equalize compression evaporation with multiple-effect evaporators as far as thermal efficiency is concerned. At the same time it must be remembered that evaporation is assumed to be accomplished by a temperature drop of 10 deg. C., and this brings us into fields of operation which seem perfectly feasible. It may be mentioned at this point that evaporators of six stages have often been constructed for the sugar industry.

The number of stages in multiple-effect evaporation is limited by practical considerations. The first stages would have to be operated under heavy pressure. This would make the plant much more expensive and more difficult to operate. In practice, therefore, the number of stages seldom exceeds three.

The considerations mentioned above hold true only for an evaporation process which is independent of other operations.

## Usual Operating Arrangements

If one should limit oneself to the above considerations alone, he would arrive at an unfair conclusion, because in modern heat practice a new basis for calculation is created by the coupling of thermal processes. Such a coupling is usually made possible in one of the following ways:

*a.* Combination of energy-producing system and evaporation process. The back pressure of the engine is used for heating the evaporation plant.

*b.* Combination of evaporation process and heating process. The vapors of the last evaporating unit are used for boiling and heating purposes, etc.

*c.* Simultaneous application of methods *a* and *b*. The boiler steam flows successively through the engine, the evaporator, and heating and boiling plant.

The possibilities of these methods of operation are shown in Fig. 1. Plans I to III refer to independent evaporation processes; plan I shows the normal single-effect evaporator; II is an example of a multiple-effect evaporator; III is a compression evaporator with a steam-driven compressor. Plan IV shows a scheme for the utilization of exhaust steam from the engine for evaporation purposes. Plan V shows the utilization of the vapors for heating purposes. Plan VI illustrates the most perfect case of the utilization of heat, thermal coupling of engine, evaporator and heating plant.

In comparing independent evaporation processes, Fig. 2 may be referred to, the calculations from which it is obtained being based on average operating conditions. The high steam consumption of the single- and multiple-effect systems is noticeable. If a comparison is to be made with the compression evaporator, it must be borne in mind that the quantity of steam needed for the compression evaporator is very nearly proportional to the temperature drop that the compressor has to overcome. The manner of calculating the quantity of steam necessary is shown in Table I. The figures in the table obtain for a temperature rise in the compressor of 19.6 deg. C. The steam consumption varies within rather wide limits according to the efficiency of compressor and driving turbine.

Table I shows that the drop in temperature is of decisive importance when judging the economy of the heating process. This varies within very wide limits in the event that increased concentration causes a considerable rise in the boiling point. This point will be considered later.

TABLE I—CONSUMPTION OF ENERGY AND STEAM FOR COMPRESSION EVAPORATOR*

| | Larger Plant | Smallet Plan |
|---|---|---|
| Efficiency of steam turbine, per cent | 0.65 | 0.45 |
| Efficiency of compressor, per cent | 0.65 | 0.60 |
| Drop of heat turbine, cal. per kg | 202 | 202 |
| Steam consumption for 1 hp. of the turbine working without loss, kg. per hr. | 3.13 | 3.13 |
| Actual consumption for 1 hp. per hr., kg. per hr. | 4.82 | 6.95 |
| Heat rising for $\frac{P_2}{P_1} = 2.0$,‡ cal. per kg | 30.5 | 30.5 |
| Actual heat consumption for the transmission of 1 kg. steam, cal. per kg | 47.0 | 50.8 |
| Steam transmission per 1 hp.-hr., kg. | 13.5 | 12.5 |
| Steam consumption in transmitting 1,000 kg. of steam, kg. | 356 | 555 |

* Steam enters at 300 deg. C. and 12 atmospheres absolute and exhausts at 0.08 atmosphere.

‡ Assuming $p = 1.0$ atmosphere absolute, $t = 19.6$ deg. C.

TABLE II—EVAPORATION WHEN UTILIZING EXHAUST HEAT

| | Single Effect | Double Effect | Triple Effect |
|---|---|---|---|
| Required evaporation, kg. | 1,000 | 1,000 | 1,000 |
| Required quantity of heating steam, kg. | 1,100 | 575 | 400 |
| Live steam consumption for back pressure engine, kg. | 1,100 | 575 | 400 |
| Live steam pressure, atmospheres | 12.0 | 12.0 | 12.0 |
| Live steam temperature, deg. C. | 300 | 200 | 300 |
| Back pressure, atmospheres | 1.2 | 1.2 | 1.2 |
| Adiabatic temperature drop, cal. per kg. | 110 | 110 | 110 |
| Turbine efficiency, per cent | 0.65 | 0.65 | 0.65 |
| Steam consumption for 1 hp., kg. per hr. | 8.85 | 8.85 | 8.85 |
| Capacity with 1,100 kg. live steam, hp. | 125 | 65 | 45.2 |
| Specific steam consumption of the condensation turbine, kg. per hr. | 4.82 | 4.82 | 4.82 |
| Hourly consumption for total capacity, kg. per hr. | 605 | 313 | 218 |
| Consequently, live steam consumption for the evaporation plant, kg. per hr. | 495 | 262 | 182 |
| Equivalent quantity of low-pressure steam, kg. per hr. | 565 | 300 | 208 |

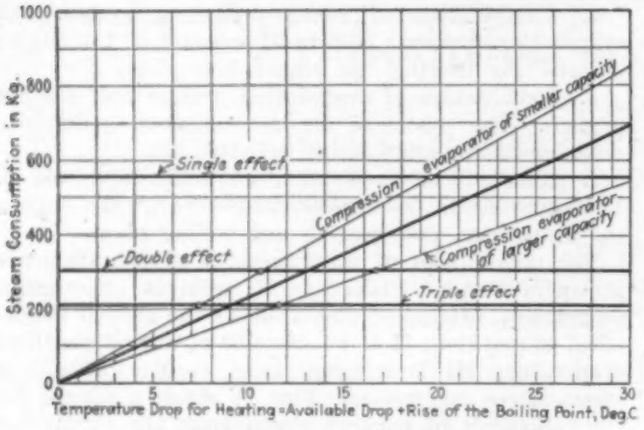



FIG. 3—COMPARISON OF VACUUM AND COMPRESSION EVAPORATORS

If it is possible to operate with a small drop in temperature, evaporation by compression may be far superior in heat efficiency to the five-stage multiple-effect evaporator; on the other hand, a rise of 20 to 30 deg. C. in the boiling point puts the efficiency on a parity with that obtained by double-effect evaporation.

As mentioned above, the evaporator plant is often heated with the exhaust steam of the engine. Thus, a new basis on which to consider the heat economy is created, and the following question is thereby raised: How can the steam consumption for the generation of energy and the heat required for the evaporation be separated in this case? This can be ascertained by subtracting from the total steam consumption of the combined plant that amount of steam consumption corresponding to the capacity of the condensing turbine. The remainder represents the steam consumption of the evaporator. An example is shown in Table II. It must be remembered in this case that the heat content of superheated live steam is not identical with that of saturated steam of low pressure. If, in spite of this, the two quantities that constitute the total required steam are equalized, the heat equivalent of the generated energy as well as the loss of heat due to radiation are fully covered. The conclusion to be derived from this example is that for the given steam conditions the heat required for the evaporation is reduced to one-half of that required with a system operating independently, provided the number of stages are the same. Fig. 3 shows the application of this deduction as a basis of comparison with compression evaporation. If, for instance, a temperature drop of 24 deg. C. is necessary, the compression evaporator equals the single-effect evaporator in efficiency, and furthermore it can be seen that even under more favorable conditions—i.e., the necessary temperature drop—favorable efficiency of compression evaporation can be maintained by arranging two or three evaporators in a series.

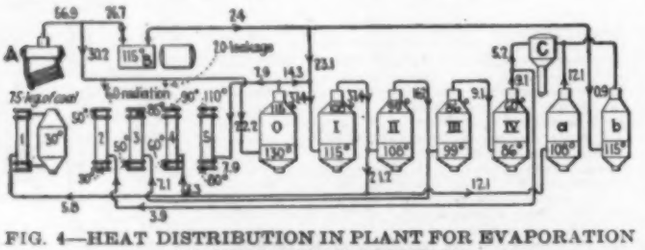



FIG. 4—HEAT DISTRIBUTION IN PLANT FOR EVAPORATION OF BEET SUGAR SOLUTION

*A*—Boiler. *B*—Engine. 1—Calorizators for diffusion. *C*—Condenser. 2-5—Heaters for thin liquor. I-IV—Evaporators. *a*, *b*—Secondary evaporators. *O*—Preliminary evaporator.

Considering now the conditions of evaporation where the exhaust steam of the evaporator is used for heating purposes, one must start from the viewpoint that the steam necessary for heating purposes is independent of the construction of the evaporation and power plants. If all the vapors of the evaporators can be used, an improvement of economy is inconceivable. No saving of heat can be obtained by compression evaporation. As an example of an installation where, by a double-thermal coupling, a perfect heat economy is attained, the manufacture of raw sugar may be mentioned, and it may be of interest to analyze such an installation in respect to heat economy, using as a basis figures obtained in practical operation.

## Heat Economy in the Sugar Industry

We may assume that the principles of the manufacture of raw sugar are known and therefore need mention only those points which are of importance to heat economy.

The total heat consumption is divided into three separate parts. The first part is required for the production of the thin sugar liquor as well as for the preparation of the same for evaporation. The second part is necessary for the evaporation of the thin liquor, in which operation large quantities of water must be evaporated and in which large quantities of heat are consequently necessary. The last part is essential to generate the mechanical energy in the engines necessary for the manufacturing process.

For the production and preparation of the thin liquor, the beet shavings must first be leached. The juice must then be heated and brought to the saturation point, and finally to the boiling point, the same temperature that prevails in the evaporator. It is customary in the sugar industry to express the necessary quantity of heat in terms of the kilograms of steam necessary for 100 kg. of beets. The figures given in Table III have been established by practical experience, and show the heat consumption for the entire operation.

TABLE III—STEAM CONSUMPTION FOR THE TOTAL PRE-HEATING FIGURED ON 100 KG. BEETS

| | Kg. |
|---|---|
| Leaching of the beets | 5.8 |
| Pre-heating of the raw beet juice | 11.0 |
| Saturation of the thin liquor and heating up to boiling point | 11.2 |

The evaporation process is divided into two stages: A primary evaporation whereby the greatest part of the water in the thin liquor is removed in multiple-effect evaporators, and a secondary step which is effected with a greater temperature drop in a single-effect evaporator under vacuum. The quantity of water that must be evaporated in this case is not very large. However, the quantity of steam necessary for its evaporation is considerable because, for practical reasons, single-effect evaporators must be chosen.

The steam consumption for the generation of mechanical energy can be calculated if the quantity of energy necessary is known. The latter is given as between 1.2 and 1.5 hp. per hour for 100 kg. of beet shavings. The generation of energy was formerly decentralized to quite an extent. Nowadays a fairly effective centralization is sought for and obtained by using electrical transfer of energy. To make a comparative analysis, losses by radiation and leakage must be considered.

The various heat-absorbing plants are coupled to-

TABLE IV—SUGAR FACTORY AT OFFSTEIN

| | |
|---|---|
| Daily quantity of beets worked, kg. | 1,500,000 |
| Hourly quantity of beets worked, kg. | 62,400 |
| Steam consumption | |
| Live steam addition, kg. per hr. | 12,000 |
| Exhaust steam of the engine, kg. per hr. | 12,000 |
| Exhaust steam of the turbine, kg. per hr. | 11,000 |
| Total, kg. per hr. | 35,000 |
| Steam consumption for total of 100 kg. beets, kg. | 56.1 |
| Hereof: (*a*) For diffusion, kg. | 5.8 |
| (*b*) For pre-heating, kg. | 22.0 |
| (*c*) For boiling, kg. | 11.9 |
| Total *a* + *b* + *c*, kg. | 39.7 |

| Conditions for operating machines | Steam Pressure Above Atmospheric Pressure: Entrance | Exhaust |
|---|---|---|
| Piston engines | 6.0 | 1.0 |
| Steam turbine | 12.0 | 1.0 |

gether thermally in a practical way. The mechanical energy is thereby generated throughout in engines using back pressure, and the total exhaust steam is introduced into the evaporators. By this method the heat consumption necessary for the generation of energy is reduced to a very small quantity. This quantity represents the heat equivalent of the energy generated, so that, not taking into consideration the radiation losses of the engines and the leakage losses, the generation of energy is produced with an efficiency of 100 per cent.

By coupling the evaporator and the diffusion and warming plants, an additional advantage is obtained—viz., that for the primary heating plant only that heat quantity need be considered which is lost in the condenser of the last evaporator. The heat distribution in a modern plant can be seen from Fig. 4, which shows that of the 56.9 kg. of steam which is necessary for 100 kg. of beet shavings, only 2.7 kg. is absorbed for the generation of energy and only 5.2 kg. for the primary evaporator, in which the greatest exchange of heat takes place. Of the remainder, 13 kg. is used for the secondary evaporator and 28 kg. is necessary for diffusion and heating purposes. Radiation and leakage losses require 8 kg. of steam. These figures were established in the operation of an Austrian sugar factory. Corresponding figures of a German factory, which are shown in Table IV, confirm the reliability and correctness of these figures.

## Considerations Affecting Steam Consumption

When endeavoring to ascertain whether and to what extent a reduction of the steam consumption is possible and practicable, the following considerations must be a guide. The heat requirement for diffusion and preliminary heating, neglecting the theoretical possibility of utilizing the hot distillate from the evaporator, must be considered as unavoidable, as well as the heat necessary for covering the losses caused by radiation and leakage. If for technical reasons boiling under vacuum in a single effect system is resorted to, it is necessary to generate this additional heat quantity in the boiler, as the heat of the vapors is consumed in the condenser. It is true, however, that the heat necessary for preheater No. 2 could be covered by its heat of evaporation, so that the quantity of steam could be reduced from 13 to 13 — 3.9 = 9.1 kg. Correspondingly, the exhaust heat of the vapors would naturally be increased from 5.2 to 5.2 + 3.9 = 9.1 kg.

The lower level of the obtainable steam consumption, taking into account the above assumptions, would be attained when this loss of the exhaust heat of 9.1 kg. is eliminated. The steam consumption for 100 kg. of beets would be 47.8 kg. The elimination of the heat loss of the condenser can be effected by two methods:

*a.* Increase in the number of the preliminary boilers arranged in series. In practice, never more than two preliminary boilers have been used.

*b.* Reduction of the steam consumption for the generation of mechanical energy, which should be tried by centralization and application of higher pressures and temperatures, whereby a larger amount of steam is made available for the preliminary boilers.

By the total elimination of the condenser losses of the evaporation plant, which is a practical possibility, the most favorable operation is obtained. A proposal to operate the evaporation plant with vapor compression would be of no advantage when the generation of mechanical energy is brought about by means of steam power. In case electrical energy can be generated by means of water power, a reduction of the operating costs would be possible only when the price of heat from electrical energy is less than that of coal, multiplied by the efficiency of the boiler. However, there is probably no locality where this is the case, even with very favorable rates for electricity. Even if such were possible, the advantages would be only slight.

## Drying Beet Shavings

If, therefore, it is desired to give further consideration to the utilization of vapor compression, the possibility of covering the unavoidable heat consumption of diffusion, preheating and boiling by heat sources which are independent of the manufacture of sugar must be investigated. Such a possibility arises if a plant for the drying of the shavings is run in conjunction with the sugar factory. As such a drying plant is to be found in most modern factories, its possibilities are worthy of consideration.

The value of the dried shavings is so great that devices for the drying of the shavings taken from the diffusion batteries have been quite generally installed, although the heat necessary for the drying is considerable, as the following figures show.

Seven kilograms of dried shavings is obtained from 100 kg. of beets. The solid and water contents are as follows: Dried shavings, 85 per cent of solids, 15 per cent of water; pressed wet shavings, 12 per cent of solids, 88 per cent of water. The quantity of water to be evaporated from 7 kg. of shavings can be calculated as follows: 7.0 kg. dried shavings contains 5.94 kg. solids and 1.06 kg. water; 51.75 kg. wet shavings contains 5.94 kg. solids and 43.5 kg. water. The production of 7 kg. of dried shavings requires accordingly the evaporation of 43.5 — 1.1 = 42.4 kg. of water.

The shavings are dried by means of a direct utilization of combustion gases, obtained by burning coal on a specially constructed grate. On the basis of tests which have been obtained in practice, we can figure on a coal consumption of 0.6 kg. coal for 1 kg. of dried shavings, so that for 7 kg. of dried shavings, corresponding to a quantity of 100 kg. of beets, a coal consumption of 4.2 kg. is necessary. Comparing this coal consumption with that necessary for the total manufacture of raw sugar, which, according to the normal conditions shown in Table IV is 7.5 kg., it follows that the consumption necessary for drying is 5.6 per cent of the total.

The 42-kg. steam obtained by the drying of the shavings has the abnormally high evaporation figure of 10, which can be accounted for by the fact that the loss of

TABLE V—DETERMINATION OF DEW-POINT

| | | | | | |
|---|---|---|---|---|---|
| Theoretical air consumption for the combustion of 1 kg. of coal... | | | | 9.7 kg. | air |
| Combustion water + water content of the air per 1 kg. of coal..... | | | | 0.5 kg. | $H_2O$ |
| Evaporation of water per 1 kg. of coal = 42.4 + 4.2 = ..... | | | | 10.0 kg. | $H_2O$ |
| Total quantity of steam per 1 kg. of coal, 10 + 0.5..... | | | | 10.5 kg. | $H_2O$ |
| Air surplus..... | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 |
| Air consumption per 1 kg. coal..... | 9.7 | 11.7 | 13.6 | 15.5 | 17.5 |
| Weight of combustion gases..... | 10.7 | 12.7 | 14.6 | 16.5 | 18.5 |
| Weight of steam..... | ..... | ..... | 10.5 | ..... | ..... |
| Steam constant of 1 kg. gas..... | 0.98 | 0.84 | 0.72 | 0.635 | 0.57 |
| Dew-point, deg. C..... | 86 | 85 | 83 | 82 | 80.5 |

the exhaust heat is very small, on account of the low exhaust temperature—about 100 deg. C.—of the mixture of the vapors and the combustion gases.

The heat of condensation of the 42 kg. of steam present in the exhaust gases is more than sufficient to supply the heat necessary for the diffusion, preheating of the juice, etc., if the two following assumptions are considered:

*a*. That the temperature at which the heat can be made available is high enough.

*b*. That the required percentage of steam can be separated from the mixture of steam and gas.

The dew-point of the mixture of steam and gas is important for the consideration of these two points, as is shown in Table V. The table shows that in practice a dew-point of 83 to 85 must be figured, which means that at this temperature the condensation of steam begins. The percentage of steam condensing is greater the lower the point at which the mixture of steam and gas is cooled. Further calculations show that the heat of about 70 per cent of the steam content can be obtained by condensing the same, if the temperature is lowered 15 deg. below the dew-point—that is, down to about 70 deg. C. This temperature, however, is sufficient for only a small part of the heat consumption of the sugar factory, and it is therefore necessary to raise the temperature by means of a heat pump.

## Effect of Drying on Heat Economy

The following considerations show how the heat economy is influenced by the utilization of the exhaust heat from the drying of the shavings and also by the necessary rise in temperature difference.

It is assumed that the mechanical energy necessary for raising the temperature must be generated by means of steam power. A study of Fig. 5 shows that of the 42 kg. of steam contained in the exhaust gases, about 16 kg. can be used in the sugar factory, which must be made available by cooling the mixture of steam and gas to from 75 to 77 deg. C. This corresponds to

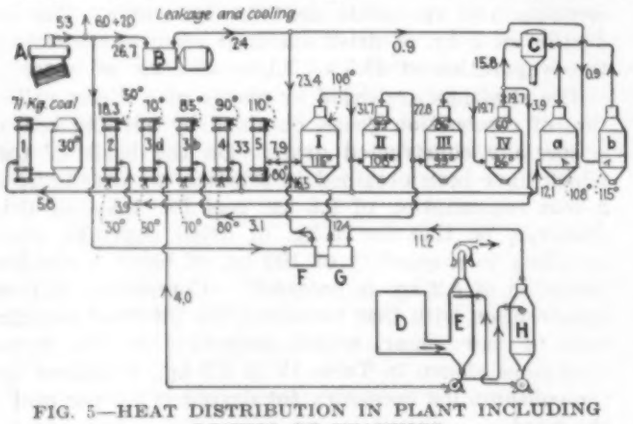



FIG. 5—HEAT DISTRIBUTION IN PLANT INCLUDING DRYING OF SHAVINGS

*A*—Boiler. *B*—Power engine. *C*—Condenser. 1—Calorizator for diffusion. 2-5—Pre-heaters for the juice. I-IV—Evaporators. *a*, *b*—Secondary evaporators. *D*—Drier for shavings. *E*—Heat exchanger. *F*—Driving turbine for heat pump. *G*—Heat pump. *H*—Heat transformer.

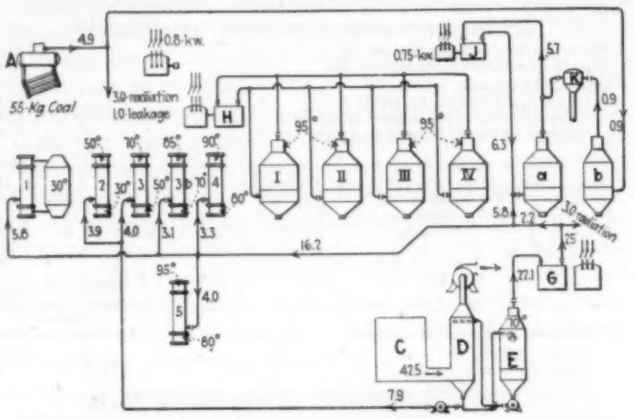



FIG. 6—HEAT DISTRIBUTION IN SYSTEM USING VAPOR COMPRESSOR ON PRIMARY AND SECONDARY EVAPORATION SYSTEMS

*A*—Boiler. *B*—Condenser. *C*—Shavings drier. *D*—Heat exchanger. *E*—Heat transformer. *F*—Vapor compressor for secondary evaporator. *G*—Heat pump. *H*—Vapor compressor. 1—Calorizator for diffusion. 2-5—Heaters for thin liquor. *a*, *b*—Secondary evaporators.

**Total consumption of electric energy—66 kw.**

a steam pressure of only 0.4 atmosphere absolute, which must be raised to a pressure of 1.6 atmospheres absolute if the heating temperature is to be 108 deg. —that is, as high as the temperature of the vapors otherwise used for heating purposes. For this purpose, the driving turbine must produce an energy of 81.5 cal. for 1 kg. of generated steam, at a compressor efficiency of 65 per cent. If the turbine is driven with live steam (of 13 atmospheres absolute and 300 deg. C.) and gives up its exhaust steam to the exhaust steam distributor at a back pressure of 1.75 atmospheres absolute, corresponding to a saturation temperature of 115 deg. C., then at 55 per cent efficiency 55.2 cal. per kg. of live steam is transformed into mechanical energy, and accordingly 0.677 kg. of vapor can be generated by means of 1 kg. of steam.

The operating conditions of the vapor compressor are shown in Fig. 5. It may be seen that a small part of the exhaust heat of the drying plant corresponding to 4 kg. of steam can be made available without a preliminary rise of temperature.

The final result of a program carried out according to Fig. 5 is a steam consumption of 53 kg. of steam per 100 kg. of beets. In contrast to the plan of Fig. 4, this means a saving of steam of 3.9 kg.—that is, 7 per cent. This saving seems to be very small, but is explained by the fact that in order to obtain the highest possible capacity of the driving engine of the heat pump, no attention has been paid to the installation of the preliminary boiler of Fig. 4. When it is considered that even without the use of the exhaust heat of the drying plant a lower level of steam consumption—viz., 48—can be reached by increasing the number of the preliminary boilers arranged in series, the conclusion may be justified that, basing the operation on steam economy alone, the use of the exhaust heat from the drying of the shavings produces no economical result.

More favorable results are obtained by providing the primary and secondary evaporation systems with a vapor compressor. In this case a much larger part of the exhaust heat of the drying plant can be used and the boiler would have to generate only a part of the steam necessary for covering the losses. Such a working plan is shown in Fig. 6, according to which 49 kg. of steam besides 6.6 kw.-hr. per 100 kg. of beets is necessary. If the electrical energy must be generated

by means of steam power in a condensing turbine, the entire steam consumption amounts to 49 kg., which is as great as when no vapor compression is used.

However, with hydro-electric energy, conditions may be entirely different, and the relation between energy and coal consumption, which is based upon the efficiency of the power engine, is eliminated. In that case it is possible to reduce the operating costs by one-half or more of the costs required with steam operation exclusively.

## Fields of Application of Evaporation by Compression

Summing up the conclusions derived from a consideration of the points outlined above, the prospects for a successful application of evaporation by compression do not appear especially favorable, if judged only from the viewpoint of heat economy. In practice, however, conditions are frequently not such as to make the evaporation a secondary operation utilizing exhaust steam. Often the problem arises how to operate the evaporation process independent of other operations in a most economical way. However, despite the fact that from a thermal standpoint nothing would hinder the multiple-effect evaporator from being operated in a manner as economically favorable as the compression evaporator, practical objections often arise against such an installation.

One principal objection to multiple-effect installations is the fact that the temperatures in the various stages are different. This results in objectionably high pressures in the first stages under certain conditions. Often multiple-effect evaporation cannot be used in any event, this being the case if, in consideration of the properties of the final product and of the physical and chemical conditions of the liquid to be evaporated, a certain evaporation temperature has to be chosen, which temperature can be raised only within small limits. In such cases the compression system has in many instances great advantage from the standpoint of heat economy. As an example, the evaporation of milk, fruit juices and tanning materials may be chosen. In inorganic chemistry, there are also many such examples.

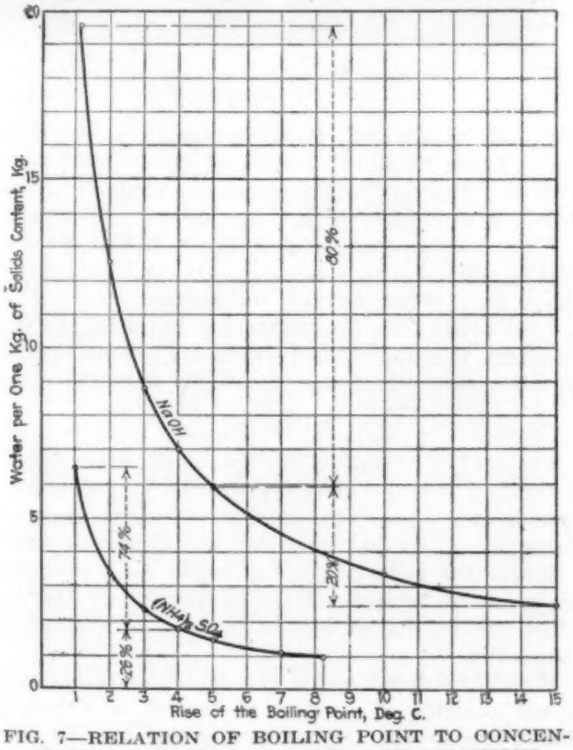



FIG. 7—RELATION OF BOILING POINT TO CONCENTRATION OF $(NH_4)_2$, $SO_4$ AND NaOH SOLUTIONS

The economy of compression evaporation can be questioned if we have to deal with a considerable rise of the boiling point. But even in such cases, larger installations can be favorably operated if we take into consideration that the rise in the boiling point is a function of the concentration. In order to explain this relation, let us turn to Fig. 7. A distinction must be made between the two principal cases. In the first, only the concentration must be raised by evaporating without a separation of the dissolved substance; in the other, the problem is to separate the dissolved substance in a solid form. In the latter case the boiling point

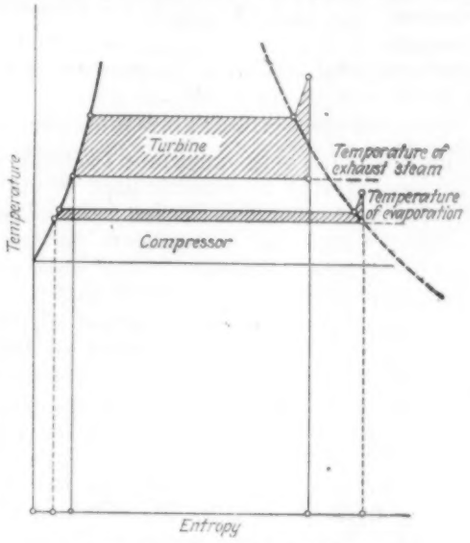



FIG. 8—ENTROPY DIAGRAM

rises to a maximum, at which point the separation of the salt begins and then remains constant. The curves, which represent the dependence of boiling point on concentration, always have a certain resemblance in character, and there are universal laws which determine this function. The figure shows the boiling conditions of caustic soda and ammonium sulphate solutions. The first case involves a concentration of the solution and the second a separation of salt. The curve shows that the rise in the boiling point, corresponding to the concentration at the start, is usually low, and that a considerable percentage of water can be evaporated with only a small rise in the boiling point of 4 or 5 deg. The practical conclusion that must be drawn from this is that the evaporation process should be done in two separate stages: A preliminary concentration in which the greater part of the water is evaporated in the compression evaporator under a slight rise of the boiling point, and a secondary evaporation with a greater temperature drop in a single- or multiple-effect evaporator heated in the usual manner.

The conditions are especially favorable for the compression evaporator, when evaporation must be done at low temperatures and when, at the same time, steam must be supplied to a heating plant. It is not possible to use the exhaust heat of the evaporator directly, because the temperature would be too low. On the other hand, in the case of compression evaporation, the exhaust steam of the driving turbine can be fully utilized at any desirable pressure—that is, at any desirable temperature. A plan of operation is shown

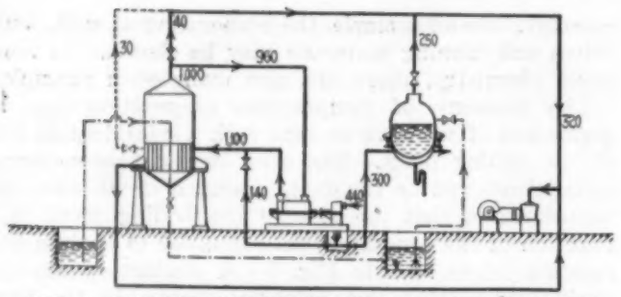



FIG. 9—SYSTEM UTILIZING EXHAUST STEAM FROM TURBINE

in Fig. 8, where, in the temperature entropy diagram, the operation of the compression and the driving engine is shown, and where the temperatures and relation of heat economy can also be seen.

An example of this basic arrangement which has been put into successful operation in practice is shown in Fig. 9.

### Evaporating Fruit Juice

A fruit juice of a very important foodstuff industry must be concentrated to a sixth part of its original weight. The final product is of such a thick consistency as to make it impossible to evaporate the last portion of water in a tube evaporator. For this purpose a steam-jacketed bowl heated with a sufficiently great drop in temperature seems to be better adapted. The evaporation temperature must be about 60 deg. C.

The evaporation is done as follows: The preliminary concentration of 1:3 is done in the compression evaporator, then the final concentration of 1:2 in a bowl. Eighty per cent of the water is evaporated in the compression evaporator; 20 per cent in the secondary evaporator. Both evaporators are operated under the same vacuum. The exhaust steam of the driving turbine of the compressor is exhausted at a pressure of 5 or 10 lb. gage and to a large extent serves to heat the secondary evaporator. The remainder serves to cover the loss by radiation.

TABLE VI—RESULTS OF A MILK EVAPORATION PLANT

| | |
|---|---|
| Concentration | 1:5 |
| Height of the barometer, mm. | 735 |
| Vacuum evaporator, mm. | 585 |
| Vacuum heating chamber, mm. | 545 |
| Estimated temperature of vapors, deg. C. | 60.3 |
| Measured temperature of vapors, deg. C. | 59 |
| Temperature of heating steam, estimated, deg. C. | 65.3 |
| Temperature of heating steam, measured, deg. C. | 65 |
| Duration of the evaporation | 6 hr., 25 min. |
| Average evaporation per hr., kg. | 1,680 |
| Voltage | 245 |
| Intensity of current, amp. | 92 |
| Energy consumption, kw. | 31.4 |
| Water evaporation for 1 kw.-hr., kg. | 53.5 |
| Water evaporation for 1 hp.-hr., kg. | 45.0 |

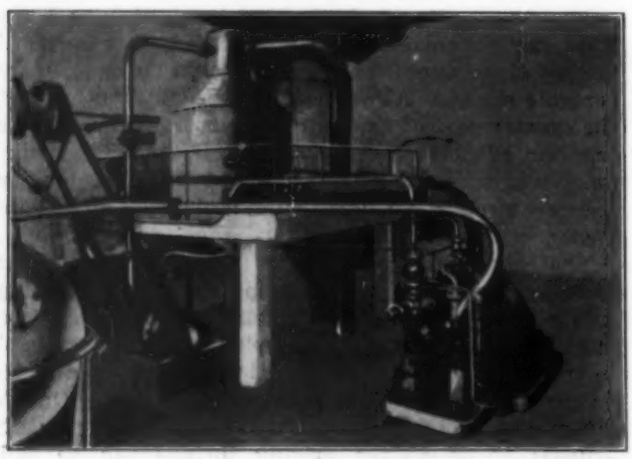


FIG. 10—INSTALLATION OPERATING ON ARRANGEMENT SHOWN IN FIG. 9

The installation shown in Fig. 9 evaporates altogether 1,000 + 250 = 1,250 kg. of water per hour. Formerly, when using a single-effect evaporator, 1,500 kg. of steam per hour was necessary. The new operation reduces the consumption to 440 kg. per hour, which means a saving of 70 per cent of the former steam consumption. Fig. 10 is a photograph of an installation which operates according to the plan shown in Fig. 9, but which has a much larger evaporation capacity. Fig. 11 shows an installation in Switzerland for the vacuum evaporation of milk. This plant is electrically operated, on account of the comparatively high cost of coal. Table VI shows results of operations over long periods. The specific figures on the evaporation capacities are therefore correct for normal operations.

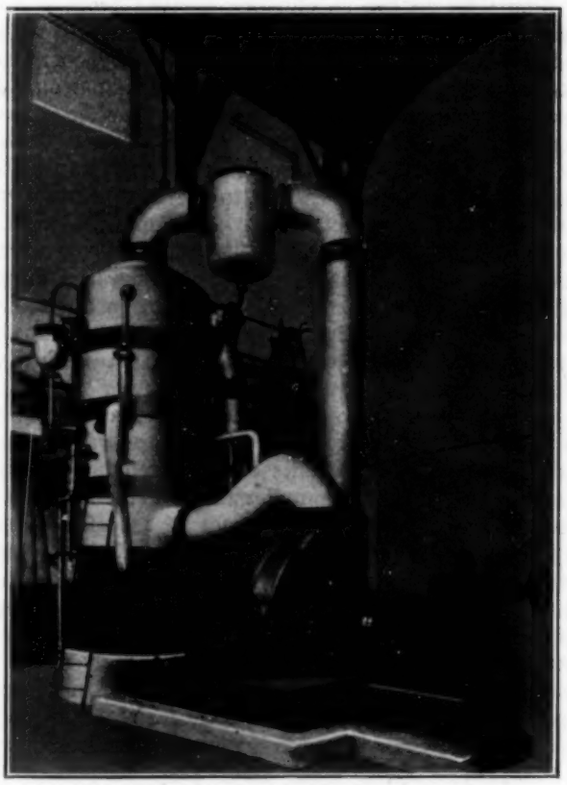


FIG. 11—SWISS INSTALLATION FOR EVAPORATION OF MILK

Fig. 12 shows another electrical installation for evaporating milk. The electric motor was eventually replaced by a steam turbine, the exhaust steam of which is used principally for preheating purposes, so that in this case the operation by means of steam proved to be much superior to the electrically operated plant.

### Résumé

The field of operation for the compression evaporator is limited. Compression evaporation may possess very considerable advantages if operated in its proper field. Examples on conditions which justify its use are:

Where the evaporation has to be done at a certain temperature because of the properties of the liquid, which means that it has to be done in a single-effect evaporator.

Where the direct use of the vapors of the evaporator is not possible on account of special conditions mentioned above—the temperature is too low, or because

the vapors carry over volatile acids and therefore it would not be possible to use them.

The characteristic of the compression evaporator which should be emphasized in connection with the use of exhaust steam is *that the temperature at which the exhaust steam is used can be made entirely independent of the temperature of evaporation in the evaporator.*

## Economy of the Compression

The capacity of the evaporator in respect to the evaporation of water depends primarily upon the extent of heating surface, the viscosity of the liquid to be evaporated, and the construction of the evaporator, especially with regard to good circulation.

On the other hand, in the case of vapor compression, the efficiencies of the compressors must be considered, and this, as previously mentioned, has a great bearing on the heat economy. Three special types of compressors have to be considered.

*a.* Piston compressor (including rotary blowers).

*b.* Turbo-compressors with steam-driven turbine (the electrical drive not to be considered).

*c.* Injector-compressors.

As a rule, the turbo-compressor is considered the most advantageous for the compression of vapors. This view is true in many cases, but not in all. The turbo-compressor allows a slight rise of temperature with good efficiencies of 60 to 65 per cent. As the rise in heat is effected by arranging separate stages in series, the efficiency can be kept at the same level independent of conditions of compression. There is no limit to the increase of the transmitted vapors as far as practical considerations go, especially when considering the possibility of arranging several units in parallel. On the other hand, the capacity of the compressor is limited. In case of small quantities of vapors, the turbo-compressor can either not be operated at all, or only at a high cost and low efficiency.

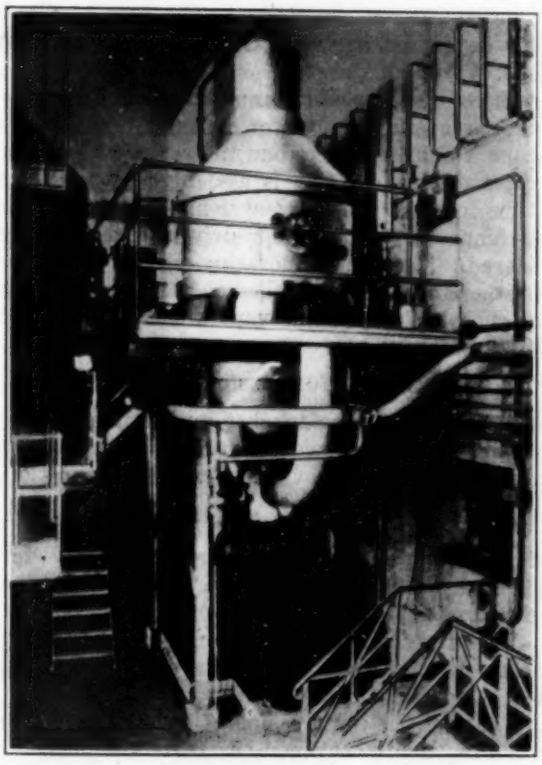


FIG. 12—ELECTRICALLY OPERATED INSTALLATION FOR EVAPORATION OF MILK

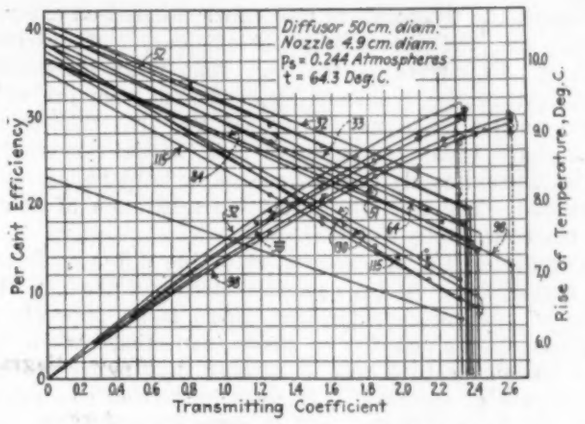



FIG. 13—THERMODYNAMIC EFFICIENCY OF INJECTOR-COMPRESSOR

The piston compressor can be built for very small quantities as well as for larger quantities of vapor. The dimensions of the piston compressor would be too great in practice for very large quantities of vapor. In that case the engine would also be too expensive in comparison to the turbo-compressor. If it is desired to evaporate under small temperature drops (and that is generally the case) then the efficiency of the piston compressor is low because the mechanical friction is great, compared to its usefulness.

The injector-compressor is of some importance. This from a thermodynamic viewpoint represents a simplification of the energy transfer of the turbo-compressor with steam-driven turbine. The transfer of energy of the turbine is characterized by the following phases: Potential energy, kinetic, mechanical, kinetic, potential. With the injector-compressor, the third stage mentioned above is eliminated and the kinetic energy is transformed directly into energy of velocity, and the latter, after being mixed with the vapors, is immediately changed back into kinetic energy. The evaporation, in the case of the injector-compressor, is in no way limited. It would be of interest to compare the three possible methods of compression in respect to their suitability for compression evaporation. This can best be done by considering the function which, bearing in mind the above question, must be chosen as the relation between capacity and that difference of saturation temperatures depending on the difference in pressure. The characteristics and efficiencies of turbo- and reciprocating compressors are known. This is not so true in the case of the injector-compressor, concerning which accurate and complete figures are not known or have not been published. This can be understood when it is remembered that correct dimensioning of the injector-compressor is of much greater importance than technical experience and practice. A consideration of the injector-compressor at this point, therefore, is made possible only by the fact that the transfer of energy has been thoroughly studied in previous theoretical and experimental investigations. It is impossible to say at this time whether the maximum conditions which have been determined can be considered as final, as the experiments have not been fully completed.

Fig. 13 shows the characteristics and efficiencies which were obtained when the dimensions of the mixture and compression apparatus were systematically changed; as abscissa, that quantity of steam was chosen which is transmitted by 1 kg. live steam; as

ordinate, the temperature rise (always based on saturation)—i.e., the thermodynamic efficiency. Characteristic of all curves is the fact that with increasing temperature the transmitting coefficient remains constant until a maximum is reached, and that then there is a sharp break in the curve and the delivery coefficient approximately decreases linearly with rising temperature. The efficiency reaches a maximum of about 32 per cent.

Comparing the characteristics of the different forms of compression, in Fig. 14, it is observed that, in the case of the turbo-compressor, there is an appreciable increase of the quantity of steam transmitted when the rise in temperature may be smaller than under normal conditions of operation. If, with increasing concentration the heat transfer, and therefore the evaporation, becomes smaller, a partial compensating effect takes place until the maximum of the increase in temperature is reached. Then, however, further decrease of the evaporation efficiency brings us into a field where the compressor "pumps" and the operation is more or less at a standstill. The pumping can be avoided by leading back a part of the vapor from the pressure side to the suction side, but this can be done only at a sacrifice of the efficiency. Attempts to avoid pumping

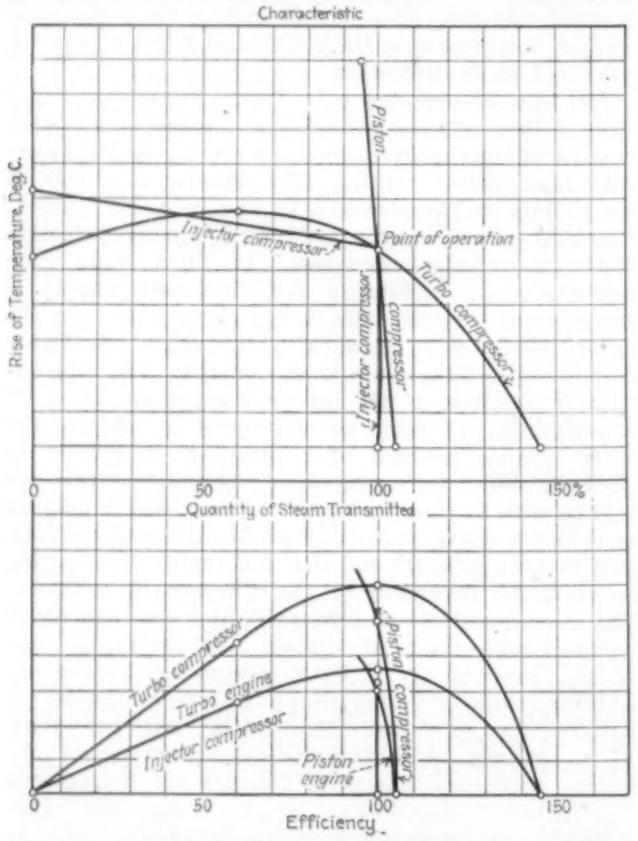



FIG. 14—COMPARATIVE CHARACTERISTICS OF DIFFERENT FORMS OF COMPRESSION

by changing the number of stages of the compression complicates the operation. If the evaporator is so dimensioned that pumping does not occur, the turbo-compressor has various characteristics favorable to its practical operation.

The piston compressor is characterized by an approximately constant transmission of steam at variable temperatures. The slight decrease in transmission at increasing temperatures is explained by the fact that with increased compression the volumetric efficiency

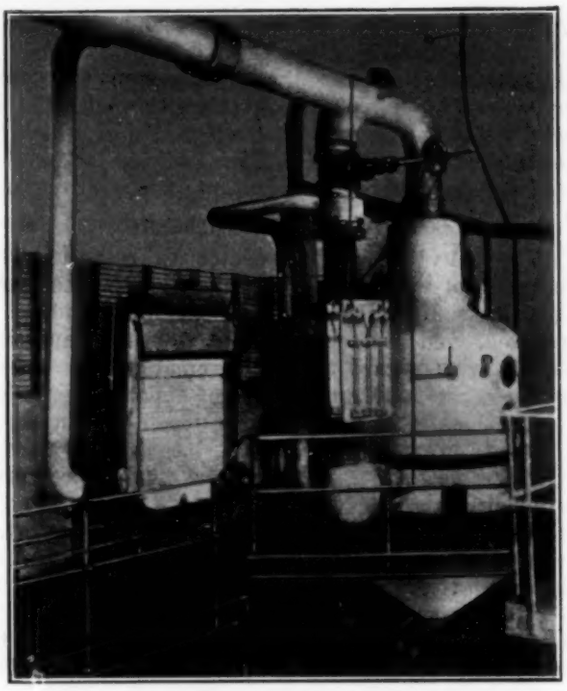


FIG. 15—VACUUM EVAPORATOR WITH INJECTOR-COMPRESSOR

decreases. The approximate constant of the steam transmission will last as long as the required capacity of the driving engine.

The injector-compressor shows a constant on the quantity of steam transmitted up to a certain rise in temperature; with a slightly increased temperature, the quantity of steam transmitted decreases. On considering the efficiencies, it may be seen that the injector-compressor under normal conditions of operation does not show up much more unfavorably than the turbo-compressor. For this reason the injector-compressor must be considered especially in the case of plants of smaller capacities in which a turbo-compressor cannot be used.

An injector-compressor cannot be used when the exhaust heat of the evaporator must be used at a temperature which is higher than the required temperature of evaporation and which is also higher than the temperature of the heating system. In that case a turbo-compressor with steam-driven turbine must be considered. Vacuum evaporating plants with injector compressor have been installed in many cases. Fig. 15 shows such a plant which evaporates 1,300 to 1,500 kg. of water per hour.

## Conclusion

The above discussion touches on the principal points which are of importance for the consideration of an economical application of compression evaporation. It has been shown:

1. That often *general* conditions of heat economy existing in a plant are of greater importance for the choice of a system of evaporation than the economy of the evaporating system itself.

2. That for compression evaporation cases where the evaporation must take place at a certain temperature should be specially considered.

3. That for the compression of vapors, a choice must usually be made between a turbo-compressor and injector-compressor, and that piston compressors are of smaller importance.

# Aims and Purposes of the American Institute of Chemistry

## Establishment of Professional and Economic Community of Interest, Followed by Professional Recognition and Acknowledged Standing

By F. D. Crane
Newark Technical School, Newark, N. J.

THE existence, no less than the prosperity, of the British Institute of Chemistry has stood for years as a challenge to American chemists. A similar society has been talked of, reported on — and the reports pigeonholed. The New Jersey Chemical Society has been urged to try it as a state matter, but some of the most interested people have been widely scattered, and many were sure that only a national society with state chapters could live. There was a strong undercurrent of belief that chemists themselves were not quite competent to say who was a chemist—indeed, the unchallenged claim was made that no one knew what a chemist was.

And now, without in the least deciding *what* they are, some chemists are very certain that they are through with being the one learned profession in the land with no economic organization. They are fed up with "hanging separately"; it can be no worse and surely will be more companionable to "hang together." The chemists made temporary organization permanent on Feb. 5, 1923, and the American Institute of Chemistry is offering membership to all who consider themselves chemists.

Should it be supported? There are good reasons why it should, the main one, the main reason for its existence, being that it is, first and foremost, an economic organization.

### What the Institute Offers

It takes a wholly unoccupied field in American chemistry, offering neither opposition to nor competition with any existing chemical society. It just says: "Are you a chemist? You are welcome to our fellowship; you will find other chemists and you can classify yourselves; we are united for our common good." That is something new in American chemistry; no other group has put being a chemist first. The Institute does this because the establishment and recognition of fellowship, of professional and economic community of interest, is its main purpose.

The next step, which must follow, is professional recognition and acknowledged standing. No other group, asking years of study and practice to attain proficiency and upon whose opinions life or property may depend, has ever rested so long without taking proper means to safeguard its members in the practice of their profession.

In some states a chemist may not get one hair legally abbreviated except at the hands of a licensed practitioner; in many his dead and empty arteries may not receive their due portion of the formaldehyde he, when living, may have made, except as it is administered by a state-licensed operator. In nearly all, perhaps by this time in all, states his accounts, whether he be alive or dead, will go smoothly before courts and tax collectors only if they are presented by a certified public accountant— that is, by a state-licensed bookkeeper. Meanwhile the chemists, "in dispersed phase," take what is handed them and are in economic competition with anyone who chooses to pass out cards printed "chemist" or who may have assumed a Doctorate on no firmer grounds than a marked foreign accent. "William's college degrees," so liberally bestowed in the early days of the Chemists' Club, when the dusky William "doctored" everybody, might stand today, to the man in the street, as well as any. How can anyone say whence they came when the holder bloweth as he listeth?

### To Establish Chemistry as a Profession

Slowly, perhaps, but surely, the American Institute of Chemistry is going to put the practice of chemistry as a profession on as certain a foundation as any other, making that foundation broad enough to hold every honest practitioner. This is not a new duty; it is a neglected one. The profession which lacks the gumption to recognize itself deserves obscurity.

Now that chemistry has ceased to be a war baby, it again sells in a buyer's market. "The way to make money is to get hold of a creative enthusiast and keep him on wages" is a recipe for riches only as long as that kept fellow spends neither some of his time nor a little of those wages in finding out what his creation is really worth. Many chemists today are on as economically false and unsound a basis as the average farmer, and since there aren't enough of them (and their wives) to elect a chemists' bloc, it is unlikely that there will be any Chemists' Chemical Banks, with easy loans, set up for their supposed benefit. Supply and demand rule mobs but serve armies; an organized profession can foresee demands and prepare to fill them, and can locate deficits and surpluses and interchange them far better than individuals. Sellers of ideas and services too often get what is left after all else are well paid simply because they know of no better market than the one at hand. The American Institute of Chemistry proposes to study impartially the markets for substances, services and ideas, putting each tub on its own bottom and then seeing that it has a fair chance to stand. It will succeed in this, because as an economic fellowship of recognized ability it will enter a seller's market with offerings worth their price because guaranted as to quantity and quality.

## Manufacture of Cane Sugar

Although the value of cane sugar has depreciated considerably, an increase in the quantity produced in the United States during 1921 is recorded in the reports of the Bureau of the Census. The total value of products for 1921 amounted to $23,153,000, as compared with $57,741,000 in 1919, representing a decrease of 59.9 per cent over a 2-year period. In compiling these statistics refineries making refined sugar from imported or domestic raw sugar have not been included, but only those manufacturing sugar, sirup and molasses directly from the cane.

The decrease in value of cane sugar has resulted in a decrease in the number of persons employed. Many of the smaller factories in operation in 1919 were reported in 1921 as idle or out of business. The decrease in number of those employed, therefore, cannot be attributed entirely to the fact that the manufacture of cane sugar is a seasonal industry, for in December, the month of maximum employment, there were 14,034 wage earners and in February and March, the period of minimum employment, approximately 1,866 — the minimum representing 13.3 per cent of the maximum.

# Legal Notes

By Wellington Gustin
Of the Chicago Bar

## Goods in Bankruptcy

### Return of Merchandise Stored Not a Preference in Favor of Creditor

Some interesting propositions are involved in the bankruptcy case of Rosenbloom Leather Co. on petition of the Consolidated Rubber Co. The case came up on a petition to review an order of the referee denying the Rubber company the right to reclaim certain rubber products in the hands of the trustee in bankruptcy which were in the physical possession of the bankrupt at the time of the filing of the involuntary petition. 280 Federal 139.

#### No Absolute Sale Involved

The bankrupt was engaged in business in Michigan and apparently had contract for the sale of the Rubber company's products in the state. The Rubber company is an Ohio corporation and was not authorized to do business in Michigan. The bankrupt was to sell the Ohio corporation's products in Michigan at a price fixed by the latter, collect the money and remit the price less his compensation, which was fixed as a commission of 12½ per cent. These provisions were strictly carried out, and the court found that the facts did not constitute an absolute sale to the bankrupt.

The referee held that the transactions between the parties was a conditional sale to the bankrupt, for resale by him, and therefore void as regards the reservation. because not filed for public record as required by Michigan law; and he further held that if such agreement would thereby create an agency in the bankrupt to sell such property for the Consolidated Rubber Co., the latter would be barred from recovery by reason of its failure to obtain a license to do business in Michigan as required by statute of that state, invalidating the contracts of foreign corporation violating such statute in this respect.

#### Goods in Question Only Stored for Rubber Company

Now further facts disclosed showed that within 4 months prior to bankruptcy the bankrupt ceased selling the Rubber company's product and it was agreed between them that the goods which then remained with the bankrupt should be stored on the premises for the Rubber company. These were the goods involved in this suit.

The U. S. District Court held that the effect of this settlement was to release both the Rubber company and the bankrupt from their respective obligations under their earlier agreement, and to restore them to the positions occupied by them before its making. After this settlement the court held the title to this merchandise was vested in the Rubber company, if not before. This disposed of the question under the original contract between the parties as to whether the agreement was one of absolute sale with an attempted retention of title, operating as a chattel mortgage lien, in the Rubber company, a contract of conditional sale, with title remaining in the Rubber company until resale by the bankrupt, or an arrangement of pure agency.

This settlement did not effect a voidable preference in favor of a creditor. The court says on the point: "The contract under which the goods were delivered to the bankrupt having been made prior to the statutory 4 months' period before bankruptcy, for a present consideration, and the rights of the parties with respect thereto bring valid and enforceable as between them, the surrender of possession of this property was merely a delivery thereof to its owner, to which the latter was entitled, and was not a transfer by the bankrupt of his property to one of his creditors and hence such transfer did not constitute a preference." 25 Sup. Ct. 306.

#### Failure to Obtain License Does Not Prevent Recovery of Property

Again, the court said the referee was in error in holding that, if the relation between the parties should be treated as that of principal and agent, and not of vendor and vendee, the Rubber company would be deprived of the right to recover by its failure, as a foreign corporation, to comply with the statute of Michigan requiring such corporation to obtain a license to do business in the state and making void all contracts entered into by any such corporation in default. It is the settled rule of the Michigan Supreme Court, by which the federal court in that district is bound, that a foreign corporation which has not obtained the necessary license to do business in Michigan does not thereby lose the right to protect and recover its property from loss or injury, where such right does not depend upon a contract made in violation of this statute, but arises irrespective and regardless of any contractual rights, and that under such circumstances it does not forfeit such property but may recover possession thereof, if otherwise entitled to it, in a proper tort action, such as replevin.

There being no fraud shown or claimed in making of either the original agreement or subsequent settlement, the court said the order of the referee must be set aside.

## Perkins Glue Patent Not Infringed

### Application of Second Step of Process to Natural Base Permissible Under the Law

Further litigation, with a most recent decision, over the Perkins reissue patent No. 13,436 (original No. 1,020,655) comes from the United States Circuit Court of Appeals, Second Circuit. Suit was begun in the District Court by the Perkins Glue Co. against the Standard Furniture Co., of Herkimer, N. Y., and there resulted in a decree for the plaintiff. This decree has now been reversed on appeal, and the cause remanded with directions to dismiss.

In the case at bar the court points out the results reached on this patent in the Circuit Court of Appeals in the case of Solva, etc., Co., vs. Perkins, etc., Co., 251 Fed. Rep. 64.[1] These results were that the process disclosed by Perkins consisted of two parts or steps, and that each of the steps considered by itself was old, but the product was new and patentable. Without agreement or disagreement with this result the court here accepted it for purposes of present decision.

After the decision in the Solva case the mandated court ruled that only these claims remained valid

[1] See also *Chem. & Met.*, vol. 28, p. 124, Jan. 17, 1923.

"which included the two steps [of the process] and only when their use results in Perkins glue, together with such additional claims as count on such glue as a product of the two steps and no others." Subsequently to this Perkins disclaimed *inter alia* from claims 13 and 38 of the reissue patent "any process of making glue excepting where the starch or starchy product of carbohydrate subjected to the process is degenerated to the extent described in" the reissue. 280 Federal 729.

In the present case it was claimed that defendant procured starch so degenerated as to be in a condition equivalent to starch treated by Perkins' first process, and then gave to that substance Perkins' second process and so obtained Perkins' product.

### Natural Product Has Properties of Degenerated Starch

Perkins' expert witness defined degeneration as "a certain proportioning of resulting viscosity, cohesiveness and adhesiveness." But defendant's evidence showed that the starchy substance or carbohydrates, called viscamite, which it used as a base for its alleged infringing glue, is a natural product, and that it received no chemical treatment whatever. The court said the fact was that the earth had been found to produce a starch which plaintiff admitted is the exact equivalent of what Perkins made by his first process.

This product of nature cannot *per se* be covered by any patent, and it certainly is not the result of any process devised by Perkins, says the court. Therefore, accepting the decision in the Solva case referred to above as interpreted and apparently acquiesced in by plaintiff, there could be no infringement, because the defendant is not using a glue which is the result of both steps of Perkins' patent.

But going further than this and examining the process used by defendant in making its glue, the court found that "starting with the natural starch base, a mixture is made ultimately containing about two and one-third parts of water to one part of starch base by weight and about 3 per cent of caustic soda based on the weight of the starch."

The court found that some accident of nature or the skill of agriculturists has produced and put on the market a cassava starch of that degree of viscosity, etc., which Perkins achieved by his degenerative process.

### Applying Second Step of Process to Natural Base Does Not Infringe

With such starch the defendant by using methods as old as the Belgian patent to Gerard of June, 1874, has produced a substance which plaintiff says is Perkins glue. Perhaps it is in result, says the court, but it cannot be the same thing in a patentable sense because nature has supplied the base and Gerard the process. The only reason that justified prior courts holding Perkins' product patentably new was by finding it the peculiar result of a combination of two processes severally old. There was no such foundation for a finding in this case. Nature or the farmer (so to speak) has superseded the first half of Perkins method, and the second half was not new; the product of a natural base treated by an old process cannot be an infringement under any view of the law.

"Plaintiff has defined its product as a 'new vegetable glue as good as animal glue for veneering.' We think that this definition is not advanced by embodying it in a laudatory phrase descriptive of intended result.

"We may agree that Perkins disclosed a 'new vegetable glue'—i.e., a manufactured product. There are some manufactured products so broadly new that the same thing, however produced, may be within the invention's broad range of equivalents. This is a question of fact, but on the prior art and the evidence herein as to modern cassava starch, Perkins vegetable glue is not such a product. We think, therefore, that the lower court fell into error in substantially paying no attention to the nature of defendant's starch base, and it is directed that the decree be reversed . . . with directions to dismiss the bill . . . on the ground of non-infringement.

## The Sulphur Industry of the World

For some years Italy has been the greatest exporter of sulphur. During the past 3 years, however, the United States has become the chief source of supply, owing to the exceptionally low cost of production. Japan now ranks third in importance as an exporter of this commodity. Although free or native sulphur is devoted to many different uses, it has been estimated that more than half the consumption is in the manufacture of sulphuric acid. Large quantities are also used in the sulphite process of digesting wood pulp for paper manufacture, as a fungicide for grape vines and hops and as a fertilizer, insecticide, fumigant and sheep dip. Moreover, the vulcanization of rubber, the manufacture of matches, explosives, dyes and cements, as well as photography and medicine, all draw heavily upon the sulphur supply.

During the war Japan, which next to the United States and Italy is the chief producer and exporter of sulphur, greatly increased its output. A record of 116,000 tons was reached in 1917, as compared with an average of 49,000 tons in previous years. Practically all the sulphur produced in Japan was exported previous to 1917, as there is normally very little demand for it in the home market. Since the war, however, both production and exports have decreased in large measure.

Of the total Japanese sulphur exports, 45 per cent went to the United States, the largest consumer, prior to the war. For the most part, these shipments were used in the paper-making industry of the Northwest. The difference in freight charges in shipments across the Pacific, in comparison with those from Louisiana and Texas, is the cause of the large amount still imported from Japan. The opening of the Panama Canal, however, has made the Gulf ports easily accessible to the Pacific Coast and in future the American producing regions can doubtless satisfy the home market. Australia had also relied upon Japan previous to the war for sulphur supplies, as she imported 35 per cent of the total Japanese output. However, in 1920, the last year for which figures are available, Japan exported the larger part of her reduced output to India, replacing almost entirely the Sicilian product.

American sulphur has recently been exported in large quantities. Previous to 1917, an average of 60,000 tons was shipped annually to foreign markets. Of this amount, 88 per cent went to three countries alone—45 per cent to France, 31 per cent to Canada and 12 per cent to Germany. In the first 9 months of 1922, statistics show that sulphur exports from the United States amounted to more than 400,000 tons and although each country imported a smaller quantity than previously, the export market has expanded so that these three countries used only 55 per cent of the total amount.

# Synopsis of Recent Chemical & Metallurgical Literature

## Byproducts Oven Heat Balance

D. S. Chamberlain and E. W. McGovern, of Bethlehem, Pa., published in *Gas Age-Record* for Feb. 17, 1923, a complete heat balance for a battery of byproduct coke ovens which gives a good check on current figures for the heat loss of endothermic reactions in the change of coal to coke.

The data used in this heat balance were obtained from a battery of Koppers ovens, which are in this case unique in that they have 106 ovens per battery. As this is the largest number of ovens per battery known to us, this operation is conspicuous in that the control is so perfect and the results so uniform. The results obtained from the following data indicate the rapid development in the construction of regenerative byproduct coke ovens.

(Basis: One gross ton of coal, dry)

| | B.t.u. | Per Cent. Input |
|---|---|---|
| Heat Available. Input | | |
| (1) Latent heat in coal | 30,369,920 | 86.71 |
| (2) Sensible heat in coal | 3,517 | 0.01 |
| (3) Latent heat in fuel gas | 3,011,840 | 8.53 |
| (4) Sensible heat in fuel gas | 3,065 | 0.01 |
| (5) Sensible heat in preheated air | 1,638,575 | 4.74 |
| Total input | 35,026,917 | 100.00 |
| Heat Distribution. Output | | |
| (1) Latent heat in coke | 21,574,175 | 61.61 |
| (2) Sensible heat in coke | 1,240,144 | 3.55 |
| (3) Latent heat in foul gas | 6,760,000 | 19.32 |
| (4) Sensible heat in foul gas | 435,103 | 1.26 |
| (5) Total heat going out stack | 1,102,690 | 3.16 |
| (6) Latent heat in tar | 1,347,200 | 3.85 |
| (7) Sensible heat in tar | 19,198 | 0.05 |
| (8) Heat absorbed in tar formation | 45,468 | 0.13 |
| (9) Radiation and convection losses | 399,840 | 1.14 |
| (10) Latent heat in light oil in foul gas | 300,037 | 0.86 |
| Total output | 33,223,860 | |
| Unaccounted for | 1,803,057 | 5.16 |
| | 35,026,917 | 100.00 |

1,803,057 ÷ 2,240 = 804.9 B.t.u. per lb. of dry coal, the heat required to coke one pound of coal.

The difference between the heat input and the heat output, as developed from the preceding data, amounts to 804.9 B.t.u. per pound of coal. On a percentage basis of 5.16, this figure comes within the range of results as determined by Constam and Kolbe. As the endothermic reactions, taking place in the coking operation, vary with the type of coal, the indication is that the heat required to coke such mixtures as used in the byproduct coke ovens in the United States is greater than that required for English coals. The B.t.u. value of 804.9 was practically checked by a heat balance run on a battery of Semet-Solvay ovens in the early part of 1922, at which time a B.t.u. value of 788.0 was obtained, amounting to a heat loss of 5.06 per cent.

In conclusion, the advance in the development of the byproduct coke oven, in so far as a heat balance is concerned, will be made evident by a decided reduction in the latent heat in the fuel gas. This will be brought about by an oven construction that will reduce the total heat going out the stack as well as reduce the radiation and convection losses. In other words, the total gas used as fuel gas for heating the battery will eventually be reduced to a percentage of 35.0 or less.

### Important Articles In Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

FACTORS INFLUENCING PROPERTIES OF WOOD CELLULOSE AS ISOLATED BY THE CHLORINATION METHOD. M. W. Bray and I. M. Andrews. *Paper Trade Journal*, Feb. 22, 1923, pp. 47-49.

PAPER PULP RECOVERY. L. M. Booth. *Paper Trade Journal*, Feb. 22, 1923, pp. 54-55.

COLORING PAPER STUFF WITH COLOR LAKES. Emil Heuser and H. G. Behr. *Paper*, Feb. 21, 1923, pp. 7-12. Translated from *Papierfabricant*, Jan. 6, 1923.

NITROGEN DISTRIBUTION IN VERTICALS. C. H. Stone. *Gas Age-Record*, Feb. 24, 1923, pp. 241-243.

THE INFLUENCE OF STIRRING ON THE RATE AND COURSE OF DEVELOPMENT. S. E. Sheppard and Felix A. Elliott. Research Laboratory, Eastman Kodak Co. *J. Franklin Institute*, February, 1923, pp. 211-228.

RESISTIVITY OF VITREOUS MATERIALS. L. L. Holladay. *J. Franklin Institute*, February, 1923, pp. 229-236.

## American and English Ball Clays

The Bureau of Standards has recently completed a study of the twenty-one varieties of ball clay that are used in the largest quantities in the manufacture of china, semi-porcelain, electrical porcelain, tile and sanitary ware. The results of this study have been made the subject of a recent publication by the bureau.

Determinations were made of the following data: Water of plasticity, amount passing through a 120-mesh sieve, shrinkage when dried, rate of flow of slips, cohesion when plastic, dry transverse strength when mixed with an equal amount of flint, time required to oxidize carbonaceous content at 750 deg. C., burning behavior, porosity and volume changes from Orton Seger cone 01 to cone 12 and coloring effect in a standard body.

The American clays were found to be much cleaner than the English clays and contained less coarse mineral matter and dirt which would be removed in lawning the body after blunging. The Kentucky clays were almost free from such material, and the Tennessee clays contained only a small amount, while the English clays were less desirable in this respect.

No great differences were noted in water of plasticity, the range of variation falling within a few per cent. The Dorset clay exhibited the highest shrinkage. All the clays studied warped in drying, but none of them developed cracks.

The transverse strength of equal mixtures of the clays with commercial potters flint was determined to give a better indication of the comparative bonding power of the clays in a body than would be indicated by the modulus of rupture of the clay alone. The average modulus of rupture of the Tennessee clays tested was 366 lb. per square inch, the Kentucky clays averaged 282 lb. per square inch, the clays from Dorset, England, 405 lb. per square inch, the Devonshire clays 443 lb. per square inch, and English clays, whose exact source was not known, 419 lb. per square inch. In general the English clays were stronger than the domestic, but two of the American clays compared favorably with the average English clay.

From the results obtained the rate of flow of slips from the efflux viscosimeter did not appear to be a valuable criterion of the inherent plastic qualities for use in comparing ball clays.

### Strength and Burning Behavior

The cohesive strengths of the plastic clays were determined at different water contents and are shown graphically. These results showed no distinctions which compared with the value of the clays for jiggering, as judged by practical potters.

Some of the English clays are very high in carbonaceous matter, 11 hours being required in two cases to remove completely the black core from specimens 1¼x1¼x2 in. The clays from Devonshire as a class required the longest time for oxidation. The Dorset clays and those from Tennessee contained a moderate amount of carbonaceous matter, while the Kentucky clays contained but little. It was noticed that there was a relationship between the amount of carbonaceous matter and the strength when dry, the more carbonaceous clays usually being stronger.

The burning behavior of the American and English clays was radically different. The English clays vitrified at a low temperature and remained almost constant in porosity and volume up to cone 12. No evidence of over-

burning was noticed at that temperature. There was some variation in the burning behavior of the clays from Devonshire, but the Dorset clays underwent practically the same changes in firing. The American clays showed a gradual reduction in porosity from cone 01 to cone 12. Tennessee ball clay No. 5 was the only domestic clay which vitrified at cone 8. Tennessee No. 3 matured at cone 10, and Tennessee No. 11 and Kentucky No. 4 at cone 12. The other two Kentucky clays studied were not vitrified at cone 12. Throughout the firing range studied the American clays were constantly changing in volume.

GENERAL RESULTS

In the standard body the Tennessee clays as a class showed the best color. The Kentucky and Devon clays were fair in this regard, while the Dorset clays were comparatively poor in coloring effect.

Although the English clays have a more desirable firing behavior and greater strength when dry, the American clays contain less material to be removed in body preparation, contain less carbonaceous matter which may lead to trouble in firing, and burn to a better color in the body. Because of their better color they may be used in larger quantities, thereby overcoming in a measure their lower strength. With a slight adjustment in flux content of the body they may be successfully used to replace the English clays.

All of the results are given in tabular form and graphically when feasible. A detailed description of each individual clay is given, and a classification of ball clays based on their properties has been drawn from the results of the work.

(Paper 227, by H. H. Shotwell. The complete paper may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents).

## Distilling Coal Tar in Europe

In the Feb. 10, 1923, issue of *Gas Age-Record*, R. Furness discusses in some detail the current tendencies in coal-tar distillation practice in Europe, with particular attention to the situation in England. A special point is made of the increased profit which may be realized by the tar producer if he carries on at least partial distillation in his own plant and does not sell the crude product.

Mr. Furness' article may be summed up as follows: The increased tendency toward decentralization of the tar distillation industry is a marked feature of European practice today, and is one which could advantageously be adopted in America. Special stills, which combine ease and cheapness in running, are available, and a broad fractionation into light oils, creosote oils, anthracene oils and pitch is effected with the greatest simplicity.

It has been shown that there are well-marked applications for these products of broad fractionation, and that the prices ruling are well maintained and represent several times the value of the crude tar, such as is sold to a central distillation plant.

If the producer of tar considers it economically justifiable to proceed some distance further and win from the above-noted broad fractions such derivatives as naphthalene, carbolic and cresylic acids, anthracene paste, etc., he is always sure of a ready market. New applications of all these products are constantly appearing. Even if hydrogenation of naphthalene and of phenol fail to come to maturity in the United States, the tar acids will find ready markets in the production of the millions of pounds of phenol-formaldehyde condensation products made here annually, and in the manufacture of synthetic tannins and other products of the dye and fine-chemical industries.

Finally, in many instances, a central distillation plant cannot absorb the output of tar from certain districts, and in other cases transport charges render the disposal of crude tar almost unprofitable. In these cases, distillation by the producer provides a happy alternative and one which is far more remunerative than that of disposing of the crude tar for fuel purposes.

# Recent Chemical & Metallurgical Patents

**Manufacture of Phosphorus**—In the following patent assigned to the Ferro Chemicals, Inc., of Washington, R. Franchot and K. P. McElroy, of Washington, claim that phosphate rock may be reduced to produce phosphorus if it is heated in the presence of carbon and silica. The high temperature necessary to produce this change, which is carried out in a shaft furnace, is achieved with producer gas. The high temperature is esential to insure the fluidity of the calcium silicate slags. The effluent gases contain both

## American Patents Issued Feb. 20, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,445,621 — Process for Vulcanizing Rubber and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to the Naugatuck Chemical Co., Connecticut.

1,445,637—Converting Aromatic Halogen Substitution Products Into Amines. Isador Miller, New York City, assignor to William M. Grosvenor, New York City.

1,445,644—Material for the Production of Carbide. James H. Reid, Pittsburgh, Pa., assignor to International Nitrogen Co., Cleveland, Ohio.

1,445,645—Process of and Material for the Production of Metal Hydrates and for the Production of Gas. James Henry Reid, Readsboro, Vt., assignor to Thomas Q. Hogan, Boston, Mass.

1,445,660—Process for the Extraction of Vanadium and Radium From Carnotite Ores. Warren F. Bleecker, Boulder, Colo., assignor to the Tungsten Products Co., Boulder, Colo.

1,445,685—Organic Arsenic Compound. Johann Huismann and Jürgen Callsen, Leverkusen, near Cologne, and Wilhelm Grüttefien, Elberfeld, Germany, assignors to Farben-Fabriken vorm. Friedr. Bayer & Co., Leverkusen, Germany.

1,445,735—Method of Producing Coke. James G. West, Pittsburgh, Pa.

1,445,919 — Treatment of Aluminum-Hydrate Sludge. Charles W. Souder, East St. Louis, Ill., assignor to Aluminum Co. of America, Pittsburgh, Pa.

1,445,935—Agitator. Arthur C. Daman, Denver, Colo., and Thomas J. Pennington, Naugatuck, Conn.

1,445,943—Method of Treating Metallurgical Products. William A. Harty, Buffalo, N. Y., and Frank W. Moore, Thorold, Ont.

1,445,954—Production of Smokeless Fuels and Coke. Stewart Roy Illingworth, Brynfedwen, Radyr, Wales.

1,445,973—Oxygenated Blast for Metallurgical Furnaces. Montague H. Roberts, Jersey City, N. J., and Claude C. Van Nuys, New York, N. Y., assignors to Air Reduction Co., Inc., New York.

1,445,989—Concentration of Minerals. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,012—Process of Preparing Oxalic Acid. George Kolsky, Mamaroneck, N. Y.

1,446,160—Soluble Arsenic Compound and Process of Making the Same. Joseph F. Cullen, Midvale, Utah, assignor to United States Smelting, Refining & Mining Co.

1,446,163—Manufacture of Oxy Derivatives of Anthraquinone. Arthur Hugh Davies, Carlisle, England, assignor to Scottish Dyes, Limited, Carlisle, Cumberland, England.

1,446,185—Process for the Production of Potassium Sulphate. Camille Horst, Wittelsheim, France.

1,446,216 — Diamino - Dioxyarsenobenzene-Silver Oxide Compound and Process of Making Same. Alfred E. Sherndal, New York, assignor to Herman A. Metz, New York.

1,446,301 — Manufacture of Threads, Filaments and the Like of Cellulose. Horace James Hegan, Coventry, England, assignor to Courtauldo, Ltd., London, England.

1,446,307—Process for the Recovery of Sulphur, Metallic Sulphides and the Like From a Condition of Emulsion Without Filtration on Evaporation. Bertram Hunt, London, England.

1,446,375 — Concentration of Oxidized Ores. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,377—Treatment of Concentrates. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,446,378 — Filtration of Ore Pulps. Walter O. Borcherdt, of Austinville, Va., assignor to the New Jersey Zinc Co., New York.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

phosphorus and potassium, and the potassium compounds separate out first, after which the gases are still further cooled so that the phosphorus precipitates. The final effluent is filtered through charcoal to remove the last traces of phosphorus, after which the coke or charcoal containing these traces of phosphorus is returned to the furnace. (1,441,573. Jan. 9, 1923.)

**Artificial Silk From Nitrocellulose**—Emile Bindschedler, of Switzerland, and George Juer, of Hopewell, Va., have assigned the following process to the Tubize Artificial Silk Co. of America. It consists esentially in treating nitrocellulose with ethyl alcohol in order to remove the water from the nitrocellulose. The dried product is then treated with acetone or one of its homologs. The resulting acetone collodion is spun into filaments by forcing it through spinnerets, and the resulting product is dried by passing warm partly dried air over it. This process, by using dry nitrocellulose and dry acetone, avoids the detrimental effect noted in other cases, and produces a lustrous silk. The acetone is recovered from the air and from the drier by means of benzene and petroleum and certain acids. (1,441,203, 1,441,204 and 1,441,205. Jan. 9, 1923.)

**Recovery of Nitrogen-Oxide Vapors**—P. A. Guye of Switzerland and Albert Schmidt of France have assigned the following patent to L'Azote Francais of Paris. Apparently aluminum oxide if perfectly anhydrous has an affinity for nitrous vapors. This affinity increases as the temperature at which alumina is dehydrated decreases. The patent is, however, applicable to dry gases only and must be carried out at low temperatures in order to obtain the highest absorption efficiency. (1,443,220. Jan. 23, 1923.)

**Process for Treating Air**—Arthur B. Lamb, of Washington, D. C., has developed a method of treating air in order to free it from suspended matter of all kinds, such as dust, smoke, pollens, bacteria, etc., and in addition to remove minute particles of such materials as saliva, respiratory excreta and other germ-laden and disease-producing particles. The general principle of the machine is that of an electric precipitator, and the particles are removed by being subjected to a strong electric potential during passage of air through the apparatus. Sterile air can thus be produced for therapeutic purposes, as, for example, in hospitals, etc. (1,442,619. Jan. 16, 1923.)

**Non-Corrosive Refrigerating Solution**—N. A. Dubois, of Needham, Mass., has discovered a remedy for the extremely corrosive action of refrigerating solutions such as calcium chloride on refrigerating pipes, automobile radiators and other metallic substances. Calcium chloride is often used because of its high solubility in water, even at very low temperatures, but even cast-iron pipes are corroded to a very great extent. The addition of one-tenth of 1 per cent of the weight of the solution of a difficultly soluble chromate, such as zinc chromate, apparently prevents any corrosive action on the part of the solution. This is a rather surprising result, but seems to have been confirmed in a parallel laboratory experiment. (1,442,330. Jan. 16, 1923.)

**Preparation of Dry Granular Calcium Acid Phosphate**—C. T. Whittier, of Jersey City, has assigned the following patent to the Royal Baking Powder Co., of New York. It deals with new methods of preparing calcium acid phosphate in any desired size of particle. The present method has consisted of grinding the material as it was produced. The new method automatically produces grains of the size desired. Calcium phosphate is treated with sulphuric acid, and the calcium sulphate impurity is filtered off. This leaves a solution of monocalcium phosphate in a more or less free phosphoric acid in solution. Previously this solution was evaporated until the mass on cooling was semi-solid. Then the free phosphoric acid was neutralized in a suitable kneading apparatus. The present system neutralizes the solution of monocalcium phosphate and sprays the dilute solution into a chamber containing hot air or heated water gas. By controlling the density of the solution and the speed of spraying, particles of almost any size can be obtained as desired. (1,442,318. Jan. 16, 1923.)

**Saline Solutions Free From Colloidal Silica**—G. A. Blanc, of Rome, Italy, has patented a process for obtaining clear saline solutions free from colloidal silica. When many minerals, silicates and silica-containing minerals are treated with acid in order to obtain part of their constituents as soluble salt, one great difficulty lies in the fact that colloidal silica is formed and comes through into the solution, making this distinctly cloudy. The process of avoiding this consists in pouring the acid solution through a layer of the silicate rock from which the soluble materials are to be extracted in such a way as to produce no stirring whatever in the bed. The colloidal silica then replaces the soluble materials of the rock and will not clog up the granular bed in any way unless there is a mechanical disturbance. The solution may then be returned to extract further soluble material. If the layer of colloidal silica which attaches itself to the granular particles is disturbed in any way, the filter bed becomes so dense that no further filtration can be effected. (1,443,674. Jan. 30, 1923.)

**Rubber Composition**—Philip Schidrowitz, of London, has developed a process for producing a solution of vulcanized rubber. Previously solutions have been prepared from rubber which has been coagulated, dried and masticated. This rubber may be dissolved in naphtha, benzine or like solvents, and may be then vulcanized by heating the solution in the presence of sulphur. This process possesses the advantage of providing vulcanized rubber solution, which could not otherwise be obtained, as vulcanized rubber is relatively insoluble. On the other hand, it is a difficult operation to carry out, and the solvents used are expensive. The present process uses uncoagulated or rubber latex, properly preserved by means of ammonia or other preservatives. The ingredients and fillers may be added and vulcanization takes place in solutions. In this way a very much cheaper solution of vulcanized rubber can be obtained and may be used for impregnating cloth, muslin and other materials. (1,443,149. Jan. 23, 1923.)

**The Recovery of Solids From White Water "in Paper Manufacturing"**—L. M. Booth, of Plainfield, N. J., has developed a process of coagulating the solid materials in the so-called "white waters" which pass through the screen of the paper machine and settle so slowly that a great percentage of them is lost. The combination of coagulants which has been used up to the present time is sulphate of aluminum and sodium carbonate, in a ratio substantially 2 to 1. These materials are added as a white powder and coagulate the solid particles to such an extent that they may be collected for re-use in paper work. (1,443,454. Jan. 30, 1923.)

**Method of Producing Carbonates of the Alkaline Earth Metals**—J. H. MacMahon, of Saltville, Va., has assigned to the Mathieson Alkali Works, Inc., of Virginia, a patent whereby sulphides of alkaline earth metals may be transformed into carbonates and the byproducts satisfactorily utilized. For example, black ash from barium converters is leached in the usual manner and the clear solution of barium sulphide is treated with ammonium carbonate preferably obtained by heating the liquor coming from the bicarbonate filters of the ammonia soda process. Barium carbonate and ammonium sulphide result from this reaction, barium carbonate being filtered and washed on appropriate presses or suction filters. Ammonium sulphide in the filtrate is then treated with caustic alkalis sufficient to form the alkali sulphides and free ammonia is obtained, which is then utilized in the ammonia soda process or in some other way. (1,444,623. Feb. 6, 1923.)

**Permanent Colloidal Solutions**—L. Lilienfeld, of Podhajce, Poland, has patented the use of alkyl and aralkyl-ethers of cellulose, starches, dextrin and the like as protective colloids. Other colloid protectors used in salve and ointment are somewhat faulty because of a property described as brittleness which they impart to the resulting ointment. This new class of bodies seem to have no such properties and the ointments are protected from bacteria infections as well. (1,444,257. Feb. 6, 1923.)

## British Patents

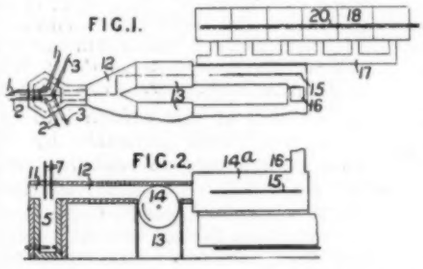
For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

**Purifying Graphite**—Natural graphite is purified from deleterious admixtures such as silica, alumina, pyrites, mica, etc., by mixing intimately with pulverized coal, charcoal or coke, and heating electrically in a retort to 2,200 deg. C. or over. The proportion of coal required is calculated on that of the impurities present so that the coal will be sufficient to unite with all the oxygen and metallic ingredients. Aluminum, iron, silicon and sulphur are in turn volatilized and may be collected in the form of their oxides in separate receptacles opened for the purpose. The silica is useful as a filtering substance, a polishing powder, etc., the sulphur dioxide for the manufacture of sulphuric acid and the metallic oxides for metallurgical purposes. (Br. Pat. 187,080. M. Langheinrich, Munich. Dec. 6, 1922.)

**Lead Salts**—Ores containing lead, preferably containing or with addition of oxidizable sulphur, are treated in the presence of dissolved chlorides with chlorine or hypochlorates at a low temperature until the lead is converted into tetrachloride and dissolved. Silver chloride remains with the residue and may be extracted with thiosulphate. The solution is separated and the surplus chlorine is blown out or reduced by reducing agents to obtain lead chloride or sulphate, or the solution is neutralized or rendered alkaline to obtain the lead as peroxide. After the separation of the lead the copper may be removed by cementation or electrolytically and the zinc electrolytically or by precipitation as hydroxide with lime. Arsenic may be precipitated previous to the separation of the copper, by oxidizing (if the solution has been reduced) to convert the iron into the ferric state and neutralizing—for instance, with a carbonate such as limestone or roasted copper pyrites or both. Carbonate ores may also be leached with the acid liquor to neutralize the liquor and extract ingredients from the ores. The reducing agents mentioned are wastes containing zinc or iron, oxidizable salts such as ferrous salts, sulphurous acid or its salts, sulphuretted hydrogen, sulphides, thiosulphates, or organic reducing agents such as sulphite cellulose waste liquor. When sulphurous acid is used the lead is precipitated as sulphate. (Br. Pat. 187,195; not yet accepted. A. Nathansohn, Berlin. Dec. 6, 1922.)

**Casein Glue**—A composition suitable for use as a glue, paint vehicle, binding agent for asbestos cement sheet, lagging compositions, paper pulp, fiber, etc., consists of casein, sodium silicate, sodium tungstate and camphor solution with or without calcium hydrate. The camphor solution is made by digesting 1 lb. of camphor in 10 lb. of spirits of wine and diluting with ether. This solution is sprayed over the casein and the solvent evaporated. The sodium tungstate is mixed with the casein, sodium silicate is added and the whole is rolled and kneaded until a powder results. This is dried and ground more finely, and the calcium hydrate added, and packed in air-tight containers. Water is added, preferably seven hours before use. Suitable proportions are casein 70 per cent, sodium silicate 27.7 per cent, camphor 0.1 per cent, sodium tungstate 0.25 per cent, and calcium hydrate about 2 per cent. (Br. Pat. 187,200. New Zealand Co-operative Dairy Co., Ltd., Auckland, New Zealand. Dec. 6, 1922.)

**Lead Sulphate**—The invention is related to the process described in specification 5299/15, wherein sulphate, sulphite and oxide of lead are obtained directly from the native sulphide by volatilizing the latter in an electric furnace. The present invention aims at the production of a product free from sulphite, oxide or unchanged sulphide. Figs. 1 and 2 show, in plan and elevation respectively, the apparatus employed. The finely crushed ore, which may have been previously concentrated, falls in regulated quantities from a




feeding apparatus through the guide tubes 7 on to the electrodes of the furnace. There are arranged in pairs 1, 1, 2, 2, etc., as shown, and are placed about 9 in. above the floor of the furnace 5. About 5 ft. above the arcs is an atmospheric intake 11 communicating through a bifurcated flue 12 with a chamber 13. A fan 14 induces a current of air over the furnace shaft 5, and the fan chambers 13 deliver into spray boxes 14a wherein the fumes are subjected to the action of water sprays delivered from the perforated pipe 15. A chimney 16 assists the flow of air and fumes through the apparatus. The water containing the reaction products passes through launders 17 into vats 18, where it may be warmed and agitated by steam pipes 20 placed on the floor of each vat. The finely crushed sulphide falls onto the arcs and is at once volatilized. The vapors rise up the furnace shaft into the current of air passing through the top of the furnace and are there oxidized. The reaction products, having been delivered into the vats 18, are agitated, and free acid may be added, if necessary, to convert any sulphites or oxides present into sulphates. The agitation serves to float any sulphide that may have escaped volatilization. This is skimmed off, dried and re-treated. The remaining liquor is neutalized with lime water, and the sulphates finally allowed to settle, decanted and dried for use as a pigment. (Br. Pat. 189,160. J. Gitsham and H. R. Evershed, Launceston, Tasmania. Jan. 17, 1923.)

**Water Softening**—A reagent for softening feedwater and preventing and removing incrustation in boilers is obtained by saturating a solution of sodium carbonate at a temperature of 5 to 10 deg. C. with aluminate and hydrate of barium and adding extract of tannin. (Br. Pat. 187,647. L. F. C. M. van Weddingen, Gand, Belgium. Dec. 20, 1922.)

**Inks and Paints**—In a process for making ink, watercolor paints and like compositions, an insoluble base is subjected to high-speed intensive mechanical disintegration with water to form a colloidal solution, to which is added, during disintegration or not, a relatively small quantity of organic dye. The base used may be clay or zirconia, which, being opaque and in colloid form, absorbs the dye to form a product of high coloring power. The base is treated with water in a colloid mill such as described in specification 155,836 and then, after settling, is again treated in the mill with a soluble organic dye in the presence of a protective colloid—for example, gum arabic—to counteract the precipitating action of electrolytes in the water, and, if copying ink is being prepared, glycol, glycerine or the like may be added. A small quantity of disinfectant may be added to prevent decomposition of the protective colloids. After standing for a time, the ink is bottled. Instead of a colorless base, colored insoluble substances such as ultramarine or lakes may be used in the colloidal state with a correspondingly less amount of dye. For india ink or watercolor paints, colloids such as cherrytree gum may be added, and colloidal clay or colloidal carbon used as the mineral base. If tannate or gallate of iron is used as the soluble ink base, an aniline dye is added to give the desired color until the iron salt is oxidized. (Br. Pat. 187,732. Plauson's, Ltd., London. Dec. 20, 1922.)

**Motor Fuel**—A homogeneous mixture of alcohol and benzol, petrol or other usual liquid hydrocarbon fuel is obtained by dehydrating the alcohol before or after mixing—for example, by the addition of calcium, calcium carbide or other substance that reacts with water and forms an insoluble product, or of an absorbent such as anhydrous lime, ferrous sulphate or potassium carbonate, or by passing alcohol vapor through a column of dehydrating material as when the alcohol is manufactured. (Br. Pat. 188,336; not yet accepted. P. Loriette, Paris. Dec. 29, 1922.)

**Sodium Salts**—Sodium bicarbonate associated with a small quantity of other soluble salts is extracted from bicarbonated mineral waters by a three-stage process consisting in heating to at least 80 deg. C. in order to remove carbon dioxide and separating the calcium

carbonate precipitated, concentrating, and finally precipitating sodium bicarbonate by passing carbon dioxide, preferably under pressure. The mother liquor adhering to the crystals after their removal contains soluble salts other than the bicarbonate. The carbon dioxide evolved in the first operation may be utilized in the subsequent step of carbonating the liquor. (Br. Pat. 188,335; not yet accepted. Appareils et Evaporateurs Kestner, Lille. Dec. 29, 1922.)

# Book Reviews

CHEMISCH - TECHNISCHE UNTERSUCHUNGSMETHODEN. Vol. I, 7th edition. 1099 pp., illustrated. Julius Springer, Berlin, 1921.

Eleven years have elapsed since the appearance of the sixth edition of this work, which is still issued under the names Lunge-Berl, although the former had no part in the production of this edition. This lapse of time has necessitated a complete rewriting of the work, in which, however, the old principles have been adhered to, in that where the subject matter concerns a given industry, first the raw materials, then the intermediate products and the process control methods, and finally the finished products are taken up and their methods of testing described.

The arrangement of the book is much the same as in earlier editions, including a general section, where such operations as sampling; preparation of samples; weighing, precipitation, drying, etc.; gravimetric analysis; volumetric analysis in all its branches; gas analysis; areometry; manometry and anemometry; measurement of heat by thermometer and pyrometer; colorimetry, and calculation of analytical results are taken up in great detail. A special section includes chapters on technical gas analysis, microchemical methods, electroanalysis, analysis of solid and liquid fuels, boiler water and technical water analysis, drinking water analysis, waste water analysis and air and its testing for various traces of impurities. Further chapters in this special section take up the manufacture of the following products with the analytical methods used therein: sulphur dioxide; nitric acid from Chilean nitrate, from the air by direct synthesis and by oxidation of ammonia; sulphuric acid by the chamber and contact processes; chlorsulphonic acid; mixed and waste acids; hydrofluoric acid; sulphate and hydrochloric acid; soda, including electrolytic caustic soda; chlorine; compressed and liquefied gases; potash salts, including bromine. In this list the following subjects are new, never having been treated in the earlier editions: electroanalysis; microchemical methods; liquid fuels and brown coal tar.

The various sections have been written by experts in their respective lines, many well-known names appearing among the contributors. To some extent this has resulted in overlapping and in a few cases in contradictory statements, though the careful editing, whose earmarks appear throughout the book, has done much to prevent this.

The typographical work and the proofreading are flawless. The profuse illustrations (291), for the most part clean line drawings, make clear the descriptions of apparatus the construction of which it might otherwise be difficult to duplicate. The paper is excellent, being of the old grade which characterized the better German books before the war.

Important tables likely to be used frequently for reference in analytical work have been reprinted on only one side of sheets which accompany the book. These can be mounted and used in the laboratory.

The book is excellent in every particular and is one no research laboratory can afford to be without. If it were available in English it would be an exceedingly valuable adjunct in works laboratories as well. It is to be hoped that a translation is in preparation.

F. C. ZEISBERG.

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STANDARD METHODS OF CHEMICAL ANALYSIS. A Manual of Analytical Methods and General Reference for the Analytical Chemist and for the Advanced Student. Edited by *Wilfred W. Scott*, M.A., in collaboration with thirty-six well-known analytical chemists. Third Edition. Two volumes. D. Van Nostrand Co., 8 Warren St., New York, 1922. Price $10 net.

The division of this edition into two volumes was made advisable by the addition of chapters on asphalts, sampling, soap, selenium and tellurium, sanitary water, molybdenum and tungsten, conversion tables, radium, rubber, solubility of substances and exposives.

Vol. I consists of three parts. Part 1 contains forty-five chapters on the analytical methods for the elements from aluminum to zirconium. Under each element, as in previous editions, the material is grouped under the headings: Physical Properties, Detection, Estimation, Preparation and Solution of the Samples, Separations, and Methods. The attempt is made to present the subjects with sufficient detail to enable one with an elementary knowledge of analytical processes to follow the directions; while long expositions, theoretical discussions and experimental data are purposely avoided. On the whole, the authors have succeeded in this attempt. In places they have been perhaps a little too brief. The analyst whose previous experience did not include considerable work on this determination would certainly have plenty of trouble following the directions for the determination of carbon in organic substances as given on page 119.

While there are naturally omissions of certain methods which one examining the book might want to see included, on the other hand much material is given here that is not readily available elsewhere. When everything is considered, this part is very well done.

Part 2 consists of six pages of qualitative tests given in tabular form and useful only in refreshing one's memory.

Part 3 presents tables and useful data and includes the usual specific gravity and conversion factor tables. In addition, on pages 710-12 there are given a great many weight, volume and energy conversion factors, which heretofore have been either wanting or scattered in various reference books.

Vol. II deals mainly with the analysis of special materials. It includes acidimetry and alkalimetry, alloys, oils, soaps, paints, cement, coal, gas, asphalts, rubber, explosives, water, standard methods of sampling and the determination of solubility. These topics are treated by men who are specialists and in general the treatments are excellent.

There are a few minor criticisms. On page 1007 we are told that "25 cc. of N/1 $H_2SO_4$ should contain 1.226075 grams" but the error of the burette in which it is measured is probably not less than 1 in 1,000. On page 1089, under Manganese Bronze, no method for aluminum is given, although manganese bronze often contains this element instead of manganese. Under specific gravity of oil on page 1111 the method which uses a plummet with an analytical balance might well have been included. Under coal sampling, on page 1216, the taking of a gross sample of 200 lb. for deliveries up to 100 tons is questionable practice even for small-size anthracite and certainly could not be defended for large sizes of coal. On page 1435, in the soap hardness table, the hardness for 3.5 cc. of soap solution should be 39.0 instead of 38.0. This is an error which should be obvious, but which has been carried from the original A.P.H.A. methods to several other texts.

In regard to the work as a whole, when one considers the labor of assembling and editing the mass of material here presented, he can only wonder that it has been done so well. The paper and print are good and the numerous illustrations are both well drawn and clearly described. This edition is an improvement on its popular predecessors and a valuable addition to any chemist's library.

JEROME J. MORGAN.

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LOW-TEMPERATURE CARBONIZATION. Report of the Fuel Research Board for years 1920 and 1921 of the British Department of Scientific and Industrial Research. Available from His Majesty's Stationery Office, Imperial House, Kingsway, London, W. C. 2, for 2s. 3d., postpaid.

This report is a résumé of the low-temperature carbonization situation in England and a report on some extended experimental research which has been in progress for several years under the Fuel Research Board. Any investigator working in this field will find the discussion and the data presented very profitable reading.

As all of the cost data are based upon English conditions, this type of information is not readily convertible to American conditions, but the data regarding yields and the observations on the effect of retort conditions upon coke structure are of great value.

R. S. MCBRIDE.

# Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

## No Action on Reparation Dyes as Congress Quits

### Adjourns Without Clearing Up Tangle—Textile Alliance Will Soon Be Liquidated—Proceeds to Go to Education

CONGRESS has adjourned without having taken action in the matter of reparation dyes. Apparently the State Department was not prepared to recommend the form the legislation should take. The profits of the Textile Alliance are understood to have been about $1,500,000. Under the agreement with the State Department, three-fourths of that sum is to be converted into the Treasury of the United States. The State Department agreed to recommend to Congress that the money be appropriated for educational and scientific work of interest to the textile and chemical industries. The remaining one-fourth is to be expended by the Textile Alliance itself for similar purposes, but in the manner it shall dictate.

When the affairs of the Textile Alliance are wound up, it is expected that approximately $1,000,000 will be turned over to the United States Treasury. At that time the State Department is expected to make its recommendation for the disposal of the money. The National Research Council has recommended that this fund be placed at the disposal of an organization to be known as the American Textile Institute, to be formed to conduct research work in behalf of the textile industry as a whole.

#### Ruhr Affects Situation

The entry of France into the Ruhr and the refusal of Germany to pay reparations in kind befogged the situation to such an extent that the State Department apparently did not regard the time opportune for legislation intended to prescribe a definite policy for the handling of reparation dyes and for their disposal in this country.

In that connection it may be pointed out that the German statement that delivery of dyes on reparation account would be withheld from France and Belgium cannot be taken seriously, since Germany does not handle the distribution of reparation dyes. She is required to deliver 25 per cent of her daily production to the Reparation Commission, which is charged with their allotment.

A significant feature of the situation is the resignation of Frederick S. Dickson as the advisor of the State Department on the subject of reparation dyes. Previously Mr. Dickson, as chief of the War Trade Board section of the Department of State and prior to that as the officer in charge of the dye and chemical control section of the Treasury Department, administered the import control over dyes and chemicals until that control was superseded by the new tariff act, which went into effect Sept. 22. Mr. Dickson expects to enter private employment, but is not yet ready to discuss the connection he probably will make.

### Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 3-7

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 4

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O., April 18-20

AMERICAN CHEMICAL SOCIETY
New York, Nichols Medal Award, March 9

SOCIETY OF CHEMICAL INDUSTRY
New York, regular meeting, March 23

SOCIETY OF CHEMICAL INDUSTRY
New York, joint meeting with other societies, April 20

## Double Duties Hamper Trade With Ruhr

With the establishment of strict customs control around the Ruhr district by the occupying French and Belgian forces, shipments for American account in and out of this area are liable to fresh delays.

The French authorities have embargoed the principal products of the Ruhr to prevent their shipment into unoccupied territory. Upon goods leaving the country, not subject to this embargo, the French levy the regular export duties. The German Government, not recognizing the authority of the French to do this, also collects the regular tax. As a result, in addition to the difficulties of transportation to and from the Ruhr district, a new impediment is added to trade with occupied Germany.

## U. S. Agriculturists Push Calcium Arsenate

### Despite High Price Experts Urge Growers to Continue Use of Poison—Increased Supply Predicted

Cotton growers are justified in paying as much per pound for calcium arsenate as they receive for lint cotton. This view is held by many government specialists who are anxious that the use of calcium arsenate be continued despite the high prices. They contend it has been demonstrated that the use of this poison results in saving sufficiently great to permit its use even at higher prices than now prevail.

Arrangements have been made by the Department of Agriculture with the Air Service of the Army for the use of planes for further experiments in the application of calcium arsenate from the air. As this is written, it seems probable that Congress will approve an additional appropriation of $60,000 to be used specifically for these airplane experiments. One of the great advantages in this mode of application is that all cotton over a large area can be dusted with the poison.

#### Arsenate Doubles Cotton Yield

In an address on the floor of the House of Representatives, Representative Wilson of Louisiana cited concrete instances where the yield of cotton had been doubled by the use of calcium arsenate. He pointed out that the boll weevil has been responsible during recent years for an average loss of six million bales of cotton annually. When to the value of that cotton is added the losses occasioned to allied industries, the total is brought to staggering proportions, he declared.

In view of the world-wide increase in the demand for cotton, a special effort is being made by government specialists and by members of Congress from the cotton-growing states to encourage the wider use of calcium arsenate despite the high price. They recognize that the quickest way to bring production abreast with demand is to pay a price which will encourage output. At the same time the Federal Trade Commission and the Department of Justice are being relied upon to discover any effort to take advantage of the existing situation to manipulate prices.

These two government agencies are paying particular attention to the spread between the prices paid producers and those charged the ultimate consumer.

# Final Dye Rules Issued by Treasury Department

## Regulations for the Entry and Appraisement of Dyes Under Tariff of 1922 Officially Issued on March 2

THE regulations for the entry and appraisal of dyes and coal-tar products in accordance with paragraphs 27 and 28 of the 1922 tariff, have been officially issued by the Treasury Department under date of March 2, 1923. The rules follow:

*Regulation* 1. *Taking Samples Prior to Entry*—An importer may be permitted under proper supervision to take samples from his own importations prior to entry of articles dutiable under paragraphs 27 and 28, and appraising officers may take samples of such articles prior to entry when deemed necessary by them.

*Regulation* 2. *Information Required Prior to Entry*—When an importer seeks information from the appraising officer prior to entry or for the importer's convenience formal entry is withheld as hereinafter provided, in return therefor the importer shall furnish to the appraising officer such relevant information as he may request.

*Regulation* 3. *Determination of Similar Competitive Articles*—(*a*) A domestic article shall be considered a similar competitive article if in the use or uses which require a major portion of the total consumption in the United States of the imported and the domestic article, the imported article accomplishes results substantially equal to those accomplished by the domestic article when used in substantially the same manner.

(*b*) An imported article which is or may be used for the same purpose as a domestic article not freely offered for sale but used in the manufacture of another domestic article freely offered for sale shall be considered a similar competitive article.

*Regulation* 4. *Lists of Competitive and Non-Competitive Article*—(*a*) The Appraiser at New York shall issue at once lists of articles which he believes to be competitive and non-competitive, and shall from time to time add articles thereto or remove articles therefrom as investigation shall justify. Such lists shall be advisory only and at the top of each list shall appear the following statement:

> This list is advisory only and in no manner relieves appraising officers from the duty of independent appraisement required by law.

The appraiser shall furnish copies of such lists and amendments thereof to the Customs Information Exchange for circularization to other appraising officers and to the public upon request.

(*b*) In the case of an actual importation of a similar competitive article the appraising officer may furnish to the importer upon application in writing informaton of the American selling price, provided the appraising officer shall be satisfied that the importer after exercising due diligence has not himself been able to obtain such information and that he has submitted to the appraising officer all relevant information in his possession. All information furnished by the appraising officer shall be advisory only. In communicating such American selling price, however, the appraising officer shall not disclose the source of his information.

(*c*) In the case of non-competitive articles appraising officers shall not advise importers prior to entry concerning values.

*Regulation* 5. *Entry of Articles on Neither the Competitive Nor the Non-Competitive List*—The Appraiser at New York upon application of an importer having an invoice of an article not named on either the competitive or the non-competitive list shall proceed immediately to ascertain to which list the article belongs, and upon such ascertainment shall add the article to such list, pending which the importer may withhold formal entry. The appraiser shall inform the importer of his action.

*Regulation* 6. *Difference in Strength of Imported and Domestic Articles*—When an imported article is of different strength from a similar competitive article manufactured or produced in the United States, the value of the imported article shall be adjusted in relation to the selling price of the domestic article in the proportion which the strength of the imported article bears to that of the domestic.

*Regulation* 7. *Determination of American Selling Price of Articles Not Freely Offered for Sale but Used in the Manufacture of Other Articles*—When an article is a similar competitive article as defined in Regulation 3(*b*), the value of the imported article shall be the American selling price of the domestic article freely offered for sale adjusted in the relation that it bears to the domestic article not freely offered for sale.

*Regulation* 8. *Ascertainment of American Selling Prcie When an Article Is Offered for Sale at Arbitrary Prices*—When the appraising officer shall be satisfied after investigation that a similar competitive domestic article is offered for sale at an arbitrary and unreasonable price not intended to secure *bona fide* sales and which does not secure *bona fide* sales, such price shall not be considered as the American selling price, and such officer shall use all reasonable ways and means to ascertain the price that the manufacturer, producer or owner would have received, within the meaning of Section 402(*f*) of the tariff act of 1922.

*Regulation* 9. *Where There Are Two or More Similar Competitive Domestic Articles*—Where two or more domestic articles are considered similar competitive articles as compared with an imported article, the American selling price of the domestic article which accomplishes results most nearly equal to those of the imported article shall be taken as the basis for the assessment of the ad valorem rate.

*Regulation* 10. *Articles Which Are Not Coal-Tar Products*—The words "similar competitive articles" in paragraphs 27 and 28 shall not be construed as relating exclusively to coal-tar products. An imported coal-tar product may be compared with a domestic non-coal-tar product, or an imported non-coal-tar product dutiable under paragraph 27 or 28 with a domestic coal-tar product, for the purpose of determining whether they are similar competitive articles. The rule provided in paragraphs 27 and 28 for the determination of similar competitive articles and the regulations herein provided shall be applied in such cases.

*Regulation* 11. *Ascertainment of United States Value*—The following instructions for the ascertainment of United States value are reproduced from Treasury Decision No. 39297 of October 31, 1922:

(T.D. 39297)

### United States Value of Imported Merchandise

Appraising officers instructed how to ascertain the United States value of imported merchandise as defined in Title IV, section 402, subdivision (*d*), tariff act of 1922.

*Treasury Department,*
Oct. 31, 1922.

To Appraising Officers:

Attention is invited to the definition in Title IV, Section 402, subdivision (*d*), tariff act of 1922, of the term "the United States value of imported merchandise."

Certain questions having arisen in connection with the application of this definition to imports classifiable under paragraphs 27 and 28 of Title I of the act, the department offers the following concrete example as best illustrating its views on the procedure and computations necessary in arriving at the United States value of such merchandise:

Assume that certain dyes classifiable under paragraph 28 were exported from Germany on Sept. 15, 1922, and imported at New York on Oct. 1, 1922; and that the "such or similar imported merchandise" which subdivision (*d*), section 402, Title IV, contemplates shall be taken as the standard of comparison was selling at New York on Sept. 15, 1922, in the usual wholesale quantities, etc., at $1.45 per lb. This price includes the various items for which subdivision (*d*) provides that allowance shall be made. Assume a maximum allowance of 8 per cent for profit; dividing $1.45 by 1.08 gives $1.34 and subtracting this from $1.45 leaves 11 cents as the amount of the profit included in the $1.45. Assume a maximum allowance of 8 per cent for general expenses, dividing $1.34 by 1.08 gives $1.24 and subtracting this from $1.34 leaves 10 cents as the amount of the general expenses, included in the $1.45. Assume that the cost of transportation, insurance and other necessary expenses from the place of shipment in Germany to New York was 3 cents and deducting this from $1.24 leaves $1.21, which includes the dutiable value and the duty. Assume that such merchandise was an article which on Sept. 15 was dutiable under section 500 of the act of Sept. 8, 1916, at 30 per cent ad valorem. Dividing $1.21 by 1.30 gives $0.93 as the value upon which duty was assessed, and which is the United States value of the merchandise imported on Oct. 1, and subject to the 60 per cent ad valorem rate provided for in the proviso of paragraph 28. When the article is subject to both a specific and ad valorem rate, the specific duty will be deducted before making the division.

The amount to be deducted as duty in each case will be governed by the amount of duty actually paid on the article used as the basis for computation.

The foregoing applies to purchased goods. In the case of consigned goods the appraiser will ascertain the amount of commission paid or contracted to be paid and allow not to exceed 6 per cent of the gross selling price, in lieu of the 8 per cent profit and 8 per cent general expense. The transportation costs and duty will be ascertained in the same manner as on purchased goods.

Appraising officers will ascertain in the usual way through the special agency service or otherwise, as provided by law and regulations the facts necessary to be used in such computations.

EDWARD CLIFFORD,
Assistant Secretary.

*Regulation* 12. *Tests*—Tests which are necessary in the appraisement of imported articles shall be made under conditions approximating as closely as practicable the conditions in which the articles will be actually used in trade or manufacture.

*Regulation* 13. *Trade Papers as Sources of Information*—Appraising officers may consult the trade papers, but the weight to be given to the quotations and other information therein is for the determination of the officers themselves.

*Regulation* 14. *Obtaining Information on Doubtful Questions*—Appraising officers at ports other than New York when in doubt on any question arising under paragraphs 27 and 28 shall take the question up direct with the Appraiser at New York, who shall give his advice as promptly as possible. If the appraising officer shall be dissatisfied with the advice of the Appraiser at New York, or the latter shall be in doubt on the inquiry, the question shall be submitted to the Department for an expression of its views.

EDWARD CLIFFORD,
Assistant Secretary.

# Engineers to Have Museum

## Mechanical Engineers Accept Smithsonian Offer for Central Unit in Washington—Others Planned

The joint committee recently appointed by the American Society of Mechanical Engineers has decided to accept the offer of the Smithsonian Institution to establish at Washington, D. C., a central historical museum of engineering, in connection with which local branches will be developed in other sections.

The museum will be a storehouse for records of American engineering achievements. It will afford opportunities for research and investigation. The plan has obtained the co-operation of the Federated American Engineering Societies, from which body the joint committee was selected by the A.S.M.E.

The Smithsonian Institution, in offering to act as custodian of collections, urged that the movement be broadened from an engineering society standpoint to that of a national museum. This idea was acceptable to the engineers and the museum will be founded on the broadest possible basis.

## Stamford Chemists Hear Prof. Johnston

**Points Out Errors in Existing Literature—Says Pressure Chemistry Is Normal Chemistry**

At a meeting of the Stamford Chemical Society, Monday evening, Feb. 26, Prof. John Johnston of Yale University gave the principal address on "Some Effects at High Pressure." Dr. Johnston pointed out the unfortunate existence of a great many errors in the literature of the subject. This situation was, of course, not confined to data on high pressures, but was perhaps particularly noticeable there because the preliminary work had been very crude. Nearly 25 years ago it was felt in many quarters that inorganic chemistry had been completed. It was a finished subject. Then Ahbegg began his epoch-making compilations which have resulted in his Handbook on Inorganic Chemistry, now a standard reference work. This served to call attention to many of the gaps in inorganic chemistry. It began to be appreciated that the selection of an arbitrary temperature for inorganic reactions such as 25 deg. C. was somewhat ridiculous; and then a great many investigators began work at high temperatures and a few at high pressures, so that we are beginning to collect data on inorganic compounds with general relation to their critical constants.

### Effects of Stress

The speaker further stated that an easy differentiation could be made between the effects of uniform and variable pressure, the latter producing stresses in the material, while the former does not. Stresses have a permanent effect on physical and chemical properties. Uniform pressure, however, causes no ultimate change. The effect of using, as a pressure medium, a substance which has a positive chemical reaction with the material compressed produces very large changes in the result. This is particularly true if calcium carbonate is measured under carbon dioxide pressure. Solubility increases seventy times within the experimental pressure range.

Dr. Johnston took particular pains to point out the fact that pressure chemistry was normal chemistry and that no abnormal effects could be traced to the influence of pressure. The statements in geological books that such and such a peculiar result was probably due to pressure must inevitably be revised, because it can be shown in the laboratory that pressure does not have any effect of that kind. Many costly industrial experiments have been attempted on the theory that pressure would have some unusual effect and many useless patents have been granted on that assumption. One of particular note was mentioned, an attempt to separate cadmium from zinc under pressure, when it could be shown from theoretical research that no such separation could possibly be effected.

## New Financing Plan Adopted by A.E.S.C.

A new plan for financing the industrial standardization work of the United States, which provides for membership dues on the basis of one cent per $1,000 of gross receipts, has been formally approved by the executive committee of the American Engineering Standards Committee. And twenty of the most influential industrial executives of the country have accepted places on an advisory committee which will co-operate with the ways and means committee in the refinancing of the American Engineering Standards Committee.

In submitting the report of the ways and means committee, A. W. Whitney, chairman of that committee and of the A.E.S.C., declared that the economies which should accrue to the industries of America, through standardization, "are to be measured in billions of dollars, not millions."

### New Class of Members

This report announces a new class of members in the A.E.S.C. to be known as "sustaining members," and provides a special service to "sustaining members," including information bulletins on developments in standardization work in this country and in every other country where industrial standardization is in progress.

The plan calls for the appointment of an engineer-translator who will provide translations of standards developed in foreign countries for the information service to sustaining members. The new information service will be an elaboration of the work which the A.E.S.C. has been carrying on in a small way, in calling to the attention of co-operating bodies and the technical press the important developments in standardization work, foreign as well as American.

## Agriculture Department Plans Work for Color Laboratory

A committee of dye chemists has been appointed by the Secretary of Agriculture upon recommendation of W. G. Campbell, acting chief of the Bureau of Chemistry, to formulate plans of work for the Color Laboratory.

The committee consists of R. Norris Shreve, secretary of the Dye Division of the American Chemical Society; Willard H. Watkins of the National Aniline & Chemical Co., Buffalo; Louis A. Olney of Massachusetts, president of the American Association of Textile Chemists and Colorists; Dr. William J. Hale, of Michigan, chairman of the Dye Division of the American Chemical Society, and Dr. Clarence G. Derick, of Buffalo, N. Y.

The laboratory has in its past work felt the need of a more intimate knowledge of the problems of the industry as a whole throughout the country. The function, therefore, of the above-named committee will be to consult frequently with the bureau so that it may be conversant with the needs of various sections and schedule its work accordingly.

## American Interests Protest British Rubber Restriction

**Firestone Leads Conference Which Urges Repeal of British Law and Seeks U. S. Source of Supply**

A campaign for the repeal of the British rubber restriction act and for the development of sources of crude rubber supply that will make America independent of other countries was inaugurated at a conference held last Wednesday in Washington between the automotive industries and government officials. H. S. Firestone, of the Firestone Manufacturing Co., was the leading spirit in the conference and acted as host to the visiting manufacturers. Philip H. Lockhart of the India Rubber Manufacturers' Association of Great Britain addressed the conference. He is vice-president of the Federation of British Industries, which includes 2,200 manufacturing firms and which is opposed to British restriction. He said, in speaking of the English manufacturers' attitude, that they do not like the restriction act in any shape or form. He said he felt sure the three representatives of the Rubber Growers' Association who came from England recently for a tour of the American rubber industries had returned to England with a much better comprehension of the wants of America than ever before.

### Resolutions Adopted

Resolutions were passed which authorized Mr. Firestone to appoint a committee to carry on this work. This committee will be announced shortly and will immediately take vigorous steps to achieve the desired ends. Plans are now being worked out for a permanent organization. In speaking of the conference Mr. Firestone said:

> The conference clearly proved that exceptional interest had been aroused over the restrictive measure, and the enthusiasm shown by the manufacturers present indicated that they felt the time was ripe for concerted action looking to the abolition of the law.
>
> Our plans now provide for a permanent organization to carry to a successful conclusion the program designed to induce Great Britain to reconsider her unwise legislation pertaining to rubber, and to promote the development of rubber plantations in the Philippines and South America, as well as in continental United States, which latter field's possibilities were presented by Secretary of Agriculture Wallace.
>
> We hope to formulate plans to give every assistance available to the Departments of Commerce and Agriculture in their respective surveys of potential rubber producing regions, realizing that the rubber industry and the general public will benefit in the end.

## Ruhr Occupation Hurts East

The Far East is feeling the pinch resulting from the uncertainty as to the delivery of German chemicals more than any other section of the world, in the purview of the Department of Commerce. Prices have advanced sharply, somewhat out of proportion to advances in other countries. Whether this has been occasioned by the low state of stocks or is due to the readiness with which they have been cornered has not been determined.

## Southern California A.C.S. Discusses Ceramics

**F. B. Ortman Details Progress in Industry and Points Out Problems Needing Solution**

At the regular monthly meeting of the Southern California Section of the American Chemical Society, held at Los Angeles on Feb. 15, F. B. Ortman, vice-president of Tropico Potteries, Inc., gave an interesting address on recent developments in the field of ceramics. Mr. Ortman classified the various clay groups to include pottery, faience, heavy clay and refractories. Glass was subdivided into building glass, pressed and blown glass, and optical glass. Enameled metal is an important development of the ceramic industries, accounting for a turnover of over $42,000,000 annually. Sanitary ware is being manufactured in rapidly increasing volume, and abrasives are assuming importance. Mr. Ortman discussed the blending of clays and the steps taken to prevent scumming and efflorescence. Details were given as to the general composition of white ware, and customery burning practice. American and European porcelain were compared.

### Developments in Ceramics

An important development in the industry has occurred in connection with drying, known as the humidity method. The humidity principle involves the boxing of the shape in an atmosphere of low temperature and comparatively high humidity for a few hours—until heated thoroughly and until a uniform vapor density has been attained. The temperature is then increased rapidly. The result is an absence of case hardening and a considerable economy in time. By the old method, the burning of terra cotta ware would take from 7 to 10 days. By the new method, the operation is completed, more efficiently, in 18 hours.

Mr. Ortman dealt at length with the subject of glazing, and discussed the troubles experienced, due to the difficulty of getting a glaze and body of uniform coefficient of expansion. Dealing with the subject of health regulation, the speaker discussed the use of lead in the ceramic industry. Mr. Ortman then paid a tribute to the leaders in the industry for the manner in which they disseminated information. The bars of secrecy that formerly characterized many operations in ceramics have been let down, and there are no trade secrets. Formulas are only of value in connection with the material and conditions at the factory in which they were developed. Technicians have nothing to lose and a great deal to gain by adopting a frank attitude toward their confrères.

### Discussion Held

H. L. Payne, the chairman, at the conclusion of the address called for discussion, mentioning that a recent issue of *Chemical & Metallurgical Engineering*, to which he referred in complimentary terms, had an advertisement for Los Angeles refractories of exceptional qualities. T. S. Curtis, the president of the Vitrefrax Company, replied, and gave some interesting information about the products in question, and the progress being made in the erection of the company's new plant. The exact analysis of this refractory, it was learned, has baffled even the most experienced.

Mark Walker, the secretary of the section, announced that Dr. Franklin, the newly elected president of the society, who is also the president of the Southern California Section, would attend the next meeting, to be held on March 16, and deliver an address on the ammonia compounds, a subject on which he is the undisputed authority. This meeting will constitute the inauguration of a lecture tour which Dr. Franklin will undertake on his way to the Eastern States.

## Bureau of Mines Car to Make a 6 Months' Trip

Contrary to the information recently published in these columns, the Bureau of Mines car "Holmes" has not been dismantled, but has started on a 6 months' trip, during which experiments will be conducted at various refractories plants. The experimental work which will be done at each of these plants is in co-operation with the Refractories Manufacturers' Association. The plants at which the experiments will be conducted follow: American Refractories Co., Baltimore; Brooklyn Fire Brick Works, Brooklyn; Lavino Refractories Co., Womelsdorf, Pa.; Kier Fire Brick Co., Salina, Pa.; Ashland Fire Brick Co., Hayward Station, Ky.; Charles Taylor Sons Co., Taylor, Ky.; Chicago Fire Clay & Retort Co., Ottowa, Ill.

### Personnel for Trip

E. P. Ogden, a ceramic engineer attached to the Columbus Station of the Bureau of Mines, is immediately in charge of the technical work that will be done at these plants. The car is accompanied by Alfred Whitford, E. M. Rupp and A. H. Fessler, ceramic engineers; R. F. Lunger, fuel engineer; F. Wentzell, laboratory assistant, and W. E. Rice, the car foreman. G. A. Bole, the superintendent of the bureau's Ceramic Station, came to Washington to confer with bureau officials and the men on the car. While the car was in the railroad yards at Washington, it was inspected by a number of public officials.

## South Starts Tire Making

A recent report from Birmingham, Ala., tells of the formation of the Murray Tire Co., to manufacture in that city various grades of automobile tires. The interests behind the new concern have long been engaged in marketing tires in the South, and because of the proximity of the source of such raw materials of tire making as cotton and corn they feel they can carry on manufacture there more cheaply than in any other section.

## Federal Jury to Investigate Paint Makers

**Attorney-General Orders Probe Into Alleged Sherman Law Violations of Paint Association**

On instructions from Attorney-General Daugherty, who is investigating charges that the Paint Manufacturers' Association of the United States is violating the Sherman anti-trust law, the federal grand jury of Philadelphia began on Feb. 26 an investigation.

Accordingly Samuel R. Matlack and George B. Heckel, vice-president and secretary of the association, respectively, were called before the jury. Mr. Matlack, who is president of G. D. Wetherill & Co., Inc., denied emphatically the charges made. Mr. Heckel said he knew of no violations of the law by the association. He further stated that the association maintained a bureau in Washington to aid the government in preventing any possible abuses.

## Texans Oppose Carbon Black Plants

The establishment and operation of carbon black plants in the Bethany natural gas region of Texas, permitted in a bill now before the Texas Legislature, are strongly opposed by chambers of commerce and other trade and civic organizations in the district. It is held that the operation of carbon black plants will jeopardize the natural gas supply seriously and curtail the chances for other industries to utilize the large deposits of clays, silica sands, ocher, iron ore and other raw materials in this district, as well as make similar curtailment in the supply of gas for domestic service. A carbon black plant, it is set forth, consumes more gas than a city of 25,000 persons each day, close to 100,000,000 cu.ft. of gas daily being utilized by the plants in the Monroe, La., field. It is also pointed out in the protest that such a plant furnishes employment for only a comparatively small number of persons, gives little revenue to the land owner, and is not desirable from a community and industrial viewpoint.

## Olive Oil Foots Hearing Is Extended

An extension of time, in the hearing before the Treasury Department in which oil importers seek the imposition of a 10 per cent duty on olive oil foots under the new tariff act, has been granted by Assistant Secretary Clifford.

The tentative plan of the Treasury to assess this commodity has aroused much protest from soap makers. The soap interests, which asserted that the commodity is sulphured oil unfit for food, have presented their case to the department quite fully. The oil importers, who feel the free import of olive oil foots is discrimination against them, were late in presenting their side of the argument and for this reason the time has been extended.

## Cotton Men Remove Hutchison

Since his election as president and managing director of the National Campaign for Boll Weevel Control, the American Cotton Association has revoked Dr. M. Reese Hutchison's appointment as managing director of research for that organization.

President J. S. Wannamaker of the American Cotton Association announces that the activities of that body are to be intensified. Plans are under way to form an independent scientific research commission which is to co-operate with state and federal agencies in studying control methods for the boll weevil menace.

## Engineering Council Meets

The executive board of the American Engineering Council, which is the governing body of the Federated American Engineering Societies, will meet in Cincinnati March 23 and 24. Government reorganization and reforestration will be among the chief questions to be discussed by the engineers, who will represent thirty national and local engineering societies.

Charles H. MacDowell of Chicago is chairman of the engineering committee which is arranging the plans. Other members are S. H. McCrory, chief of the Division of Agricultural Engineering, U. S. Department of Agriculture; W. H. Hoyt of Duluth, Minn.; and J. C. Ralston of Spokane, Wash.

## Assistant Patent Examiners Wanted

The United States Civil Service Commission announces an open competitive examination for assistant examiner, Patent Office, to take place on April 4, 5 and 6, 1923, at various post offices and custom houses throughout the country. Vacancies in the Patent Office at an entrance salary of $1,500 and $20 per month bonus will be filled from the results of this examination.

Those desiring to take the examination should apply immediately to the United States Civil Service Commission, Washington, D. C., for full information, stating the name of the examination which they desire to take and applying for form 1312.

## Government Seeks Chemists

The United States Civil Service Commission announces open competitive examinations for the positions of chemist ($3,000 to $5,000 per year), associate chemist ($2,000 to $3,000 per year) and assistant chemist ($1,600 to $2,000 per year). The vacancies to be filled are in the Chemical Warfare Service, Edgewood Arsenal, Md. There are also some positions of similar qualifications.

Applicants can secure full information by writing to the Civil Service Commission at Washington, D. C. Application blanks, Forms 2118 and 2376, can be secured from the following places: Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Custom House, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif., Denver, Colo.; Old Custom House, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or the Chairman of the Porto Rican Civil Service Commission, San Juan, P. I.

Applications must be filed with the Civil Service Commission, Washington, D. C., with the material required, prior to closing March 27, 1923.

## Chemistry Institute Meets

At the regular meeting of the Council of the American Institute of Chemistry on Feb. 26, new applicants were elected to membership and plans completed for the circularization of American chemists on the desirability of affiliation with this strictly economic society of chemists.

Dr. Frederick D. Crane was appointed chairman of the classification committee, L. R. Seidell of the employment committee and H. G. Byers of the ethics committee. Reports were read announcing the early establishment of chapters and of the growth of interest in the plans of the Institute throughout the country. Chemists interested in the efforts of this organization to establish the professional status of chemists on an economic as distinguished from a scientific basis are urged to send their suggestions to the Council, 381 Fourth Ave., New York.

## Imports Statistical Service to Expand

The Department of Commerce is planning to expand its statistical service on chemical imports. This will include the entire synthetic organic group. At present an accurate picture of the volume of many imports cannot be had, due to the lack of subdivision. For the import statistics to be of greatest value, it is necessary in many instances to describe the individual commodities or qualities of a commodity. The House Committee on Appropriations has allowed a deficiency appropriation of $150,000 with which to expand the imports statistical service.

## Gas Association Convention Fixed

The American Gas Association will hold its 1923 convention at Atlantic City during the week of Oct. 15. This decision has been reached after a canvass of the entire membership of the association, which resulted in 71 per cent of the votes for Atlantic City. The convention there will be supplemented by an extended exhibition probably on the Steel Pier. In reaching this decision the committee has tentatively recommended that the 1924 convention be held in Chicago.

## New Law Establishes Naval Stores Standards

The Senate Committee on Agriculture and Forestry favorably reported a bill to establish standard grades of naval stores, under direction of the Secretary of Agriculture, which was passed in the closing hours of Congress and signed by the President.

The bill as passed is a complete substitute for previous measures on this subject which have been pending before the committee. It embodies the fundamentals agreed upon between the Department of Agriculture and a committee representing producers and large consumers of naval stores.

Three standard grades of turpentine are established, "gum spirits of turpentine," made from gum from a living tree; "steam-distilled wood turpentine," which shall be wood turpentine distilled with steam from the oleoresin within or extracted from the wood; and "destructively distilled wood turpentine," which shall be wood turpentine obtained in the destructive distillation of the wood. Two classes of rosin are established, "gum rosin" and "wood rosin," with thirteen grades.

The Secretary of Agriculture is authorized to change grades or to create new grades after 6 months' notice to the trade. Sale of naval stores not within the standards, or false gradings, would be made punishable by a fine not to exceed $5,000 or imprisonment of not more than a year, or both.

## Baby Element Was Expected

Chemists at the Bureau of Mines are inclined to accept the accuracy of the observations resulting in the announcement that a new element had been discovered. This element has been called hafnium, as has already been announced in our columns. Work at the Bureau of Mines has indicated the probability that an element exists which belonged to that point. The element having an atomic number of 72 was missing from the series, and on the periodic table it will come between lutecium, which has an atomic weight of 175, and tantalum, which has an atomic weight of 181.

## Paper Exposition Announces Speakers

The Paper Industries Exposition, which is to be held at Grand Central Palace, New York, the week of April 9, has secured as speakers for Printers, Publishers and Advertisers day, Friday, April 13, Don C. Seitz of the New York *World* and Dr. R. E. Rindfusz, secretary American Writing Paper Co.

Mr. Seitz, who is business head of the *World*, will discuss the newsprint situation from the point of view of both manufacturer and consumer, for the *World* owns its own paper mills. Dr. Rindfusz will speak on the "Standardization of Bond and Ledger Papers," a task on which his organization, in co-operation with numerous consumers, has long been working.

## Increased Paper Output In Newfoundland

An agreement which will increase the output of the paper mills of the Anglo-Newfoundland Development Co. at Grand Falls, N. F., by 100 tons per day has been arrived at between Lord Rothermere and Sir Richard Squires, representing the Government of Newfoundland. Premier Squires, in announcing the arrangement, said that no concessions were involved and that the deal was a straight business proposition. Work will be commenced on the concessions as soon as possible and, in conjunction with the Sir W. G. Armstrong Whitworth development at Humbermouth, will provide for a total increase in the dominion's paper output of 500 tons per day. When these two developments are completed Newfoundland will manufacture approximately 2,500,000 tons per annum.

# Personal

R. V. AGETON, of the Bureau of Mines staff, has gone to Pitcher, Okla., to work with Dr. F. Flynn of the Public Health Service on a study being made of the dust conditions in zinc and lead mines at that point.

Dr. EDGAR C. BAIN has gone to Dunkirk, N. Y., with the Atlas Steel Corporation as research metallurgist. He still maintains contact with the National Lamp Works of the General Electric Co. through the Cleveland Wire Division, in a consulting capacity.

CHARLES A. BLOOMFIELD, head of the Bloomfield Clay Co., Metuchen, N. J., was honored on his seventy-fourth birthday, Feb. 25, by having a large framed portrait hung in the new ceramics building, Rutgers College, New Brunswick, N. J., in recognition of his accomplishments in founding the ceramics department at the institution.

A. E. BUCHANAN, JR., has resigned as assistant editor of *Chem. & Met.* to become assistant secretary of the Alumni Association, Lehigh University, Bethlehem, Pa., which is a newly created position. He was married to Miss Lois Pease on Feb. 22 and expects to assume his new duties early in March, after returning from Bermuda.

JOSEPH R. CARPENTER, a scientific assistant, has been appointed to a position in the Color Laboratory of the Bureau of Chemistry, Washington, D. C., by transfer from the Fixed Nitrogen Research Laboratory of the Department of Agriculture.

NORRIS GOODWIN is now general manager of the International Chemical Products Co., Glendale, Calif.

H. A. GREAVES and H. ETCHELLS have been awarded jointly the certificate of merit of the Franklin Institute, Philadelphia, Pa., for notable and oirginal inventions for their electric steel melting furnaces, known as the "Greaves-Etchells" type furnace.

O. S. KEENER, junior chemist, has been transferred from the Carbohydrate Laboratory, Bureau of Chemistry, Washington, to the St. Louis station. J. L. SULLIVAN, food and drug inspector, has been transferred from St. Louis to Chicago, and Inspector WILLIAM B. TIEDT has been transferred from Chicago to St. Louis.

THOMAS MIDGLEY, JR., will be presented the Nichols Medal on March 9, for his work in the development of the anti-knock compounds for internal combustion engines.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, spoke at Princeton University March 1, on radium.

J. S. NEGRU has left the editorial staff of *Chem. & Met.* to take up engineering practice with special reference to mining engineering. He will also handle industrial diamonds for diamond drilling.

W. O'NEILL, vice-president and general manager of the General Tire & Rubber Co., Akron, Ohio, gave an interesting and instructive address before the members of the Down Town Association at Hotel St. Francis, San Francisco, Calif., on Feb. 15 on the subject "What About the Rubber Industry?"

HAROLD J. PAYNE, a '22 graduate of M.I.T., who has been with the General Electric Co. at Pittsfield, Mass., since his graduation, is now an editorial assistant on the staff of *Chem. & Met.*

ALFRED I. PHILIPPS, formerly associate gas engineer, National Bureau of Standards, and lately service engineer of the American Gas Association, is now gas engineer with Arthur D. Little, Inc., Cambridge, Mass.

T. T. READ, chief of the Information Service of the Bureau of Mines, has returned from a visit to a number of South American countries.

Dr. WALTER ROSENHAIN, the English scientist, gave two brilliant lectures at Carnegie Institute of Technology, Pittsburgh, on Feb. 12 and 13. The subject of his first address was "Metallurgical Research at the National Physical Laboratory, Teddington, England," and the other was on "Strain, and Its Relation to Fractures of Metals."

GEORGE P. SHINGLER, JR., has been appointed as an associate chemist in the Leather and Paper Laboratory of the Bureau of Chemistry, Washington, D. C., by transfer from the Chemical Warfare Service.

F. C. WEBER, chemist in charge of the Animal Physiological Laboratory of the Bureau of Chemistry, resigned at the end of January, to accept a position with the Fleischmann Laboratories, New York City.

# Obituary

DAVID AUGUSTUS DECROW, manager of the waterworks department of the Worthington Pump & Machinery Corporation, New York, died in East Orange on Thursday, Feb. 15, and was buried in Lockport, N. Y., Sunday, Feb. 18. He was born in Bangor, Me., and was graduated from Maine State College of Mechanic Arts of the University of Maine at Orono, in the class of 1879.

After his graduation from college, Mr. Decrow taught school for a year or more in a lumber camp in Maine. He went from Maine to Lockport in the early '80s and became associated with the Holly Manufacturing Co. as a mechanical draftsman. In 1893 he was made designing engineer, in 1900 chief engineer and in 1903 secretary of the company. During his connection with that plant he became known as a waterworks engineer and continued his work as a specialist in that line to the time of his death. Some years ago the Holly Manufacturing Co. was combined with the Snow Steam Pump Works at Buffalo, N. Y., as part of the International Steam Pump Co. Mr. Decrow went to Buffalo at the time of this change and took charge of the pumping machinery manufactured by both companies.

The International Steam Pump Co. was succeeded by the Worthington Pump & Machinery Corporation in April, 1916. Soon thereafter Mr. Decrow was called to the head office in New York as manager of the waterworks department and continued in this position until his untimely death. He is survived by his wife and two sons.

JAMES T. HEAD, for many years in charge of the production of potassium cyanide and other p oducts at the local plant of the H. V. Davis Chemical Works, New Bedford, Mass., died Feb. 8, of Bright's disease, at the age of 72.

CHARLES PHILIP MONTO, chemical engineer, died in Kotka, Finland, Feb. 17, 1923. He was connected with the National Carbon Co., Cleveland, Ohio, the Nungesser Carbon & Battery Co. of Cleveland, Ohio, and the Superior Carbon Products Co. of Poughkeepsie. He sailed for Finland in June, 1921, to engage in the manufacture of carbon electrodes and batteries, in which business he was engaged at the time of his death, which occurred from pneumonia. His body is being brought to this country for interment in Canandaigua, N. Y.

WADE A. TAYLOR, a prominent steel manufacturer and chairman of the board of the American Zinc Products Co., Greencastle, Ind., died at Pasadena, Calif., Feb. 17, of heart disease. He was head of the Deforest Sheet & Tin Plate Co., Niles, Ohio, until that company was acquired by the Republic Iron & Steel Co. He is survived by his wife and daughter.

# Market Conditions

## In Chemical, Metallurgical and Allied Industries

### A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities Prevailing Prices and Market Letters From Principal Industrial Centers

## Rising Prices and Production Costs Accompany Greater Industrial Activity

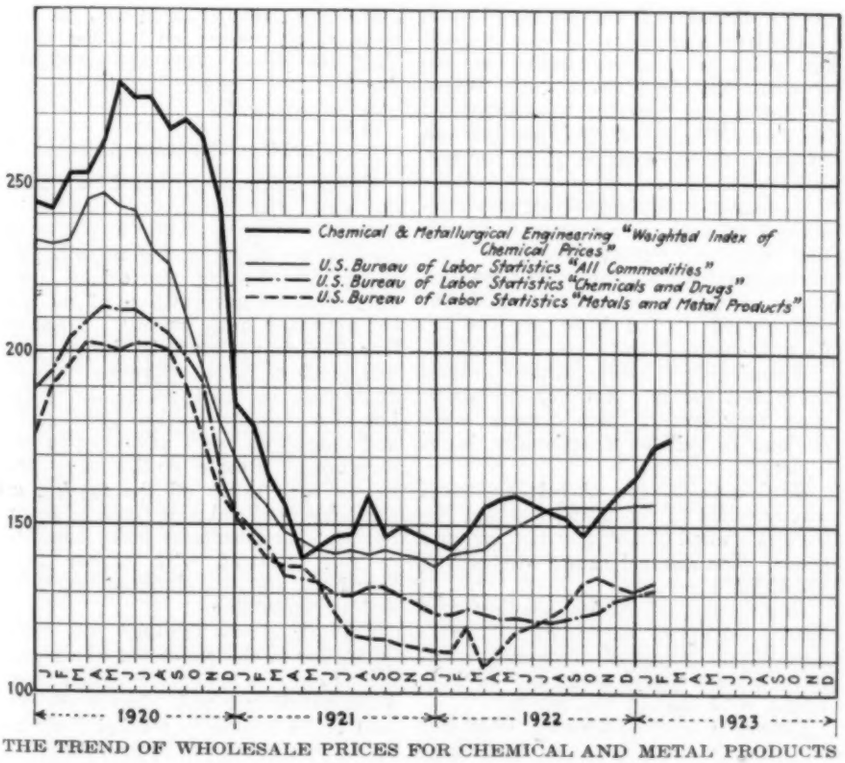
### Increased Output of Basic Commodities and Better Business Conditions in Wholesale and Retail Trade Mark Progress Since First of Year—Labor and Transportation Difficulties Foreseen

THERE is abundant evidence that the business revival has continued to gain momentum since the first of the year. Capacity operations on the part of most manufacturing industries and the volume of wholesale trade limited only by transportation difficulties are encouraging developments of the past 30 days. As yet there is but little of the speculative bidding and duplication of orders that usually accompanies an artificial business boom, but nevertheless some apprehension is being felt because of the surging rise in prices and production costs. Further advances in raw material prices threaten to carry manufactured goods to still higher levels and thereby enhance the danger of a runaway market, speculation and paper profits. Rather it is to be hoped that before long an equilibrium can be reached in industrial conditions so that production and consumption can proceed without the violent fluctuations noted during the past few months.

#### Many Industries Active

Cotton goods, pig iron, steel ingots, locomotives, zinc, bituminous coal, and wood chemicals are some of the industries showing the largest output since the boom of 1920. *The Survey of Current Business* on Feb. 26 makes the following comments on these industrial activities:

> Cotton consumption by textile mills in January was the third largest in our history, totaling 610,375 bales. Wool receipts at Boston were very heavy in January, with foreign wool receipts the highest since April, 1921. Silk consumption increased to 34,680 bales, while stocks declined from the December high mark.
>
> Pig-iron production at 3,229,604 tons was the largest since October, 1920, while steel-ingot production at 3,717,071 tons in January was not exceeded since March, 1920. Unfilled orders of the United States Steel Corporation increased after 2 months of declines and made a high record since February, 1921, at 6,910,776 tons. Merchant pig-iron shipments, unfilled orders and stocks increased, but sales declined.
>
> Shipments of locomotives were the largest since January, 1921, and unfilled orders were the highest on record, at 1,788 locomotives.
>
> Production of zinc rose to 92,634,000 lb., the highest since March, 1920, while stocks declined to 33,148,000 lb., the lowest since the armistice.
>
> Production of bituminous coal in January amounted to 50,123,000 tons, the highest month with one exception since December, 1920.
>
> Figures on rubber tires, which have just become available, show a slightly increased consumption of rubber, but a falling off in production of tires. Shipments of tires increased and stocks were reduced.
>
> Building contracts awarded in the 27 Northeastern States in January increased 1 per cent over December and 31 per cent over January, 1922.
>
> Wood chemical plants produced about twice as much acetate of lime and wood alcohol in December as a year ago.
>
> Receipts of turpentine and resin were higher than in January, 1922. Stocks of resin were larger than a year ago, but turpentine stocks were smaller.
>
> Receipts and shipments of flaxseed were less than in December, but greater than a year ago. Stocks declined to a total of only 82,000 bushels at Minneapolis and Duluth.




THE TREND OF WHOLESALE PRICES FOR CHEMICAL AND METAL PRODUCTS

### "Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

| | |
|---|---|
| This week | 176.71 |
| Last week | 176.38 |
| March, 1922 | 156.00 |
| March, 1921 | 157.00 |
| March, 1920 | 252.90 |
| April, 1918 (high) | 286.00 |
| April, 1921 (low) | 140.00 |

The slight advance in this week's index number is due to fractional increases in the prices of caustic potash and linseed oil. Other prices were well maintained and no declines were reported.

Crude oil production continues at an altogether unprecedented rate. The American Petroleum Institute estimates that the daily average gross production for the week ended Feb. 24 was 1,784,700 bbl., as compared with 1,757,550 bbl. for the preceding week and 1,410,450 for the corresponding period in 1922.

#### Threatening Shortage of Labor

A factor which may act as an important check on further business expansion is the rather general shortage of labor. Many plants reported an inadequate labor supply in January, according to the United States Department of Labor. The monthly survey made by that department in 4,153 representative establishments in 43 manufacturing industries showed an increase of 1.4 per cent in the number of employees during January. The greatest increase was in the pottery industry

(36.9 per cent), due to resumption of production following a general strike. Fifty-two fertilizer plants reported an increase of 10.8 per cent. There were 3.3 per cent more workers in the 74 chemical plants that report to the department.

### Chemical Prices Advance

For the past 3 or 4 months the average wholesale prices as recorded by the index numbers of the government and other agencies have been fairly constant. Closer study, however, reveals the fact that prices for certain basic commodities have stiffened considerably and this has been offset by declines in other prices. Since the first of the year the prices for the principal chemical and metal products have shown marked advances. These are indicated in the accompanying chart comparing this magazine's weighted index of chemical prices with the index numbers of the U. S. Bureau of Labor Statistics.

## January Steel Production Breaks All Records

Steel production increased rather sharply in January, is increasing now, and promises to be higher still this month. January broke all records since the armistice, with the exception of March, 1920. March, 1923, is practically certain to beat that record and may possibly beat the highest record during the war. Both high points were reached on the eve of limiting influences developing. The high point in the war was in September, 1918, just before the influenza epidemic, with a rate of about 47,000,000 tons of ingots a year, while the high point since the armistice was in March, 1920, just before the "outlaw" railroad strikes began April 1, the rate being about 45,000,000 tons.

Ingot production ran at an average of about 34,500,000 tons a year for 6 months following the coal strike of April 1, 1922, then averaged 40,000,000 tons in the last 3 months of the year, and was at about 43,500,000 tons in January. Of late pig-iron production would have supported a slightly higher steel production rate than has obtained, the difference probably lying in mills replenishing pig-iron reserves, entirely depleted during the coal strike.

## Business Failures Fall Off During February

Bradstreet's report on the total number of business failures during January, 1923, was 20 per cent less than the total for January a year ago, and the February total shows a decrease of 24 per cent from the like month of 1922. Measured in terms of liabilities, the January total fell 49 per cent from last year and that for February shows a decrease of 45 per cent.

These two months mark the recession from the high totals which have characterized these reports during the past 2 years.

# Moderate Activity Again in Evidence in New York Chemical Market

### Most Prices Well Maintained—Alkali Market Shows Improvement—Producers of Bicarbonate of Soda and Iodides Announce Advances

NEW YORK, March 5, 1923.

THE chemical market showed moderate activity during the past week, although trading was mostly for small quantities. Imported commodities continued to feature the market, due to the inability of German manufacturers to make any definite deliveries on old contracts. Permanganate of potash was very firm, and much higher prices were recorded among leading importers. Producers of bicarbonate of soda announced higher prices at the works, due to increased costs of production. The export inquiry for caustic soda showed a marked improvement and several large tonnage sales were reported to Japan and Europe. Soda ash has also shown a firmer tendency on spot. Arsenic continued along former levels, with buyers showing little disposition to purchase in round quantitties. Recent advances in copper sulphate were well maintained and the buyers showed additional interest in the general movement. Importers of glaubers salt reported a scarcity on spot and quoted $1 per 100 lb. for shipment in bags. Manufacturers of iodides announced an increase of 15c. per lb. Importers of caustic potash were quite firm in their views and quoted much higher prices on limited stocks of spot material. Yellow prussiate of soda was somewhat weaker, due to the absence of any large buying interest.

### Principal Price Changes

*Alcohol*—The tone of the market for methanol and denatured alcohol showed a marked improvement. Prices did not change, however, and denatured No. 1 continued at 38@40c. per gal. and methanol 97 per cent at $1.25 per gal. in barrels.

*Ammonium Sulphate*—Spot goods remained in very scarce supply, due to the increased export demand. Producers reported a heavily sold up condition at the works. Resale material was quoted around $3.85 per 100 lb., f.a.s., in double bags.

*Arsenic*—Spot goods ranged around 15¼@15¾c. per lb. Activity has slackened considerably and dealers were anxious to sell at fractionally lower figures.

*Barium Carbonate*—A better demand was reported for spot material and importers quoted $72.50 per ton for spot goods. The general range was around $72.50@$75 per ton.

*Bicarbonate of Soda*—Leading producers advanced prices on all packages due to increased production costs. Barrels were quoted at 2c. per lb. f.o.b. works, with kegs at 2¼c. per lb.

*Caustic Potash*—Imported 88-92 per cent material on spot was in very scarce supply. Sales during the latter part of the week were recorded up to 8c. per lb. Shipments were quoted at 7¾c. per lb. c.i.f. N. Y.

*Caustic Soda*—The export market showed material improvement, with several fair-sized sales reported to Japan and Italy at $3.45@$3.50 per 100 lb. The domestic market continued along firm lines, with quotations ranging around $3.75 per 100 lb. ex-store. Contracts were quoted at $2.50 per 100 lb., basis 60 per cent f.o.b. works.

*Chlorate of Soda*—A firm market was reported, with sales around 6¼@6¾c. per lb. f.o.b. works. Imported material held at the same level.

*Copperas*—Spot goods were quoted at 1¾c. per lb. in barrels. Bulk material at the works held around $16.50 per ton and $19 in bags. The demand, however, was merely of a routine nature.

*Fluoride of Soda*—A quiet market was reported among importers, with quotations around 9c per lb. Domestic producers continued to quote 10c. per lb.

*Iodides*—Large producers announced advances on all iodides. Potassium iodide is quoted at $3.75 per lb., with resublimed around $4.55 per lb.

*Permanganate of Potash*—The market was in a very strong condition with importers quoting limited stocks on spot at 20c. per lb. Shipments were held at 18¼c. per lb. duty paid. The new level represents an advance of 2c. per lb. during the past week.

*Prussiate of Potash*—Yellow prussiate was somewhat higher on spot, with quotations around 38@39c. per lb. The red variety remained at 80@85c. per lb. The demand showed considerable improvement.

### Coal-Tar Products Active

Crude products continued very scarce on spot and producers reported a heavily sold up condition at the works. Buyers are experiencing extreme difficulties in locating appreciable quantities and the general tone of the market appeared quite strong. Naphthalene has shown material improvement and dealers have withdrawn former quotations on spot material. Phenol has also shown a marked improvement and quotations were advanced in most directions. Resale stocks have practically been taken off the market and available material now remains in first hands. Intermediates have continued in fair demand, with higher prices heard for alpha-naphthylamine, R salt and paratoluidine.

*Cresylic Acid*—Trading was rather quiet, due to the restricted offerings. A few odd lots on spot were quoted around $1.50@$1.65 per gal. Importers were said to be unable to market their material on account of the prevailing high duty.

*Naphthalene*—Prices were quoted at higher levels, due to the increased consuming demand. Sellers are quoting flakes at 6¾@7c. per lb. and balls at 7¾@8c. per lb.

*Phenol*—Cheap lots have been absorbed and higher prices were quoted by holders of spot goods. The U.S.P. prime crystals were quoted around 40@45c. per lb. The demand was quite active.

## Satisfactory Business in the Chicago District

### Actual Sales Not Large, but Prices Are Holding Firm—Imported Chemicals Scarce

CHICAGO, ILL., Mar. 1, 1923.

The chemical market in the Chicago district for the past 2 weeks was quiet with only a fair amount of business reported. Although no really large orders were consummated, all factors seemed satisfied with the volume they were doing. Prices held firm and as material was apparently in strong hands, there was little or no evidence of shading. Imported chemicals were all firm and in view of the conditions abroad a general advance would not be surprising.

*Caustic soda* was quiet and not much material moved on spot. The price was unchanged at $4.15 per 100 lb. for ground 76 per cent material and $3.50 for the solid. *Soda ash* was in routine demand and spot material was unchanged at $2.25 per 100 lb. *Caustic potash* was in good demand and the price was very firm at 8½@9c. per lb. for the imported 88-92 per cent. Importers of this material claim that the spot price is still below the replacement cost.

#### Alum in Better Demand

*Potash alum* was in better supply and the iron-free lump was available at 4½@5c. per lb. The powdered was still scarce and what was available was held at 8@8½c. per lb. *Sal ammoniac* was in good demand and the white granular of domestic manufacture was quoted at 8c. per lb. in small or moderate lots. *Ammonium carbonate* was quiet at 10@10½c. per lb. *Barium chloride* was offered in one direction at $95 per ton in ton lots. *Barium carbonate* was quiet and spot material could have been purchased at $80 per ton. Only one small lot of *white arsenic* could be located, and this was held at 17c. per lb. *Blue vitriol* was quite active, with a few outside lots still available at 6½c. per lb. *Carbon tetrachloride* was in plentiful supply and the general quotation was 9½@10c. per lb. *Carbon bisulphide* was unchanged in price and small or moderate lots were offered at 7@7½c. per lb. *Formaldehyde* was quiet, with a few outside lots quoted at 16c. per lb. *Glycerine* firmed up, but the spot price of 18½c. per lb. for c.p. material in drums was unchanged.

Due to fresh arrivals *phosphoric anhydride* was offered slightly lower at 35c. per lb. for 1-lb. tins in case lots. *Potassium bichromate* was in a firm position, with spot supplies held at 12½@13c. per lb. *Chlorate of potash* was scarce on spot, and only odd lots were available at 10@10½c. for the crystals and 9c. for the powdered. *Potassium cyanide* was unchanged at 55c. per lb. for single-case lots. *Permanganate of potash* was sharply advanced and 20@22c. per lb. was the range at which spot material was available. *Yellow prussiate of potash* was quoted at 40c. per lb. and was in fair supply. The *red prussiate* was still scarce, although slightly easier at 90c. per lb.

*Linseed oil* was in better demand during the past week, although the volume was far from large. Boiled oil was quoted at the close of today's market at $1.10 per gal. in single drums and similar quantities of raw at $1.08.

*Turpentine* continued to move slowly, but the price kept advancing. Today's market for single drums delivered to the buyers' store was $1.59 per gal.

## Advances in Steel Prices Uniformly Accepted

### Ingot Production Now at Record Rate of 45,000,000 Tons Per Year

PITTSBURGH, March 2, 1923.

Following advances in prices made by certain independent sheet manufacturers—other independents being out of the market—and reported a week ago, the American Sheet & Tin Plate Co. on Feb. 26 advanced its prices $3 a ton on blue annealed to 2.65c., $3 a ton on black to 3.50c., $5 a ton on galvanized to 4.60c. and $6 a ton on automobile sheets to 5c. These prices are somewhat below those of independents, which are 2.75@2.90c. on blue annealed, 3.60c. on black, 4.75c. on galvanized and 5.35c. on automobile sheets.

The leading interest was already practically sold up through June, while it had not opened order books for third quarter and will not do so for a month or two still. There was a double object in formally advancing prices at this time—to discourage customers from seeking to place additional tonnages, and to prepare the way for third quarter transactions.

At the same time the leading interest advanced its price on tin plate from $4.75 to $4.95 per base box, 100-lb. Late last week two large independent producers had formally announced advances in their prices to $5. Some independents had previously sold at $5 and even higher. Peculiar conditions exist in tin plate. Prices of steel and pig tin have advanced since order books were opened late last November for the current half year, when they were expected to decline, demand is proving remarkably heavy and shortage of labor and steel is likely to prevent full operation of the mills in the second quarter. Makers of packers' cans expect to be taken care of at a uniform price during a half year, on the ground that they sell their cans in advance, whereas tin plate mills are faced with a loss on any tin plate they may ship at $4.75, not covered by raw material bought at the former market. There is likely to be quite a range in selling prices in the next few months, according to the position and standing of the buyer.

Standard railroad spikes have been advanced, effective Feb. 27, from 2.90c. to 3.05c., for spikes ⅜ in. and heavier.

No other important advances in steel products are recorded in the week, but all commodities show still more strength and there is more talk of premiums on small lots for early delivery, particularly in bars, shapes and plates.

#### Production at High Level

The rate of ingot production at the beginning of this month is probably well in excess of 45,000,000 tons a year, against a rate shown for January of about 43,500,000 tons. The average rate of production in 1920, a good year, and 1921, a poor year, in which there was consumption of steel and manufactures of steel previously made, was 30,000,000 tons a year—i.e., there was over 40,000,000 tons in 1920 and under 20,000,000 tons in 1921.

The very magnitude of the present demand for steel foreshadows a labor shortage in the spring, when outdoor work is to be resumed on a very large scale. The mills have a very fair labor supply now, but cannot meet competition of contractors, who simply bid whatever is necessary to get the men they must have to complete contracts. It is possible that there will be another general wage advance in the steel industry in the next month or two, even though another advance would be regarded as economically unsound.

#### Coke and Pig Iron

The buying movement in Connellsville furnace coke for second quarter, noted in last report as having just begun, has proceeded apace. According to the best estimate, more than 200,000 tons a month has now been placed under contract, all at $7 with the exception of one of the earliest contracts. This represents more than half the current supply, but production is going to increase, just as a number of furnaces, lately idle, are going to operate in second quarter. The market shows a strength which is remarkable and which was more or less unexpected. The coke market has taken its cue from the steel market rather than from the coal market, which has been declining and which promises prices during the remainder of the year at no more than a moderate margin above cost of production.

Pig iron is strengthening in practically all districts. In the local market bessemer has advanced 50c. in the week, and basic and foundry easily retain the advance of $1 recorded last week, at $27 and $28 respectively. Predictions are common that pig iron will soon reach $30, but such an advance is by no means assured, since consumers are already covered on very considerable tonnages for second quarter, and some idle furnaces are coming in.

# Current Prices in the New York Market

## FOR CHEMICALS, OILS AND ALLIED PRODUCTS

**Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.**

### General Chemicals

| | | | |
|---|---|---|---|
| Acetic anhydride, 85%, drums | lb. | $0.36 – | $0.38 |
| Acetone, drums | lb. | .22 – | .23 |
| Acid, acetic, 28%, bbl. | 100 lb. | 3.15 – | 3.40 |
| Acetic, 56%, bbl. | 100 lb. | 6.25 – | 6.50 |
| Glacial, 99½%, carboys | 100 lb. | 12.00 – | 12.50 |
| Boric, crystals, bbl. | lb. | .11½– | .11¾ |
| Boric, powder, bbl. | lb. | .11 – | .11½ |
| Citric, kegs | lb. | .49 – | .50 |
| Formic, 85% | lb. | .15 – | .17 |
| Gallic, tech. | lb. | .45 – | .50 |
| Hydrochloric, 18° tanks, 100 | lb. | .90 – | 1.00 |
| Hydrofluoric, 52%, carboys | lb. | .12 – | .12½ |
| Lactic, 44%, tech., light, bbl. | lb. | .11 – | .11½ |
| 22% tech., light, bbl. | lb. | .05 – | .05½ |
| Muriatic, 20°, tanks, 100 | lb. | 1.00 – | 1.10 |
| Nitric, 36°, carboys | lb. | .04½– | .05 |
| Nitric, 42°, carboys | lb. | .06 – | .06¼ |
| Oleum, 20%, tanks | ton | 17.00 – | 18.00 |
| Oxalic, crystals, bbl. | lb. | .12½– | .13 |
| Phosphoric, 50% carboys | lb. | .08 – | .09 |
| Pyrogallic, resublimed | lb. | 1.50 – | 1.60 |
| Sulphuric, 60°, tanks | ton | 9.00 – | 10.00 |
| Sulphuric, 60°, drums | ton | 12.00 – | 14.00 |
| Sulphuric, 66°, tanks | ton | 14.50 – | 15.00 |
| Sulphuric, 66° drums | ton | 19.00 – | 20.00 |
| Tannic, U.S.P., bbl. | lb. | .65 – | .70 |
| Tannic, tech., bbl. | lb. | .40 – | .45 |
| Tartaric, imp. crys., bbl. | lb. | .30½– | .31 |
| Tartaric, imp., powd., bbl. | lb. | .31 – | .32 |
| Tartaric, domestic, bbl. | lb. | ..... – | .32 |
| Tungstic, per lb. | lb. | 1.00 – | 1.20 |
| Alcohol, butyl, drums, f.o.b. Terre Haute | lb. | .23 – | .25 |
| Alcohol ethyl (Cologne spirit), bbl. | gal. | 4.75 – | 4.95 |
| Alcohol, methyl (see Methanol) | | | |
| Alcohol, denatured, 188 proof No. 1 | gal. | .38 – | .40 |
| Alum, ammonia, lump, bbl. | lb. | .03½– | .03½ |
| Potash, lump, bbl. | lb. | .03 – | .03½ |
| Chrome, lump, potash, bbl. | lb. | .05½– | .05½ |
| Aluminum sulphate, com., bags | 100 lb. | 1.50 – | 1.65 |
| Iron free bags | lb. | .02½– | .02½ |
| Aqua ammonia, 26°, drums | lb. | .06½– | .07½ |
| Ammonia, anhydrous, cyl. | lb. | .30 – | .30½ |
| Ammonium carbonate, powd. casks, imported | lb. | .09½– | .10 |
| Ammonium carbonate, powd. domestic, bbl. | lb. | .13 – | .14 |
| Ammonium nitrate, tech., casks | lb. | .10 – | .11 |
| Amyl acetate tech., drums | gal. | 2.80 – | 3.05 |
| Arsenic, white, powd., bbl. | lb. | .15½– | .15¾ |
| Arsenic, red, powd., kegs | lb. | .13 – | .13½ |
| Barium carbonate, bbl. | ton | 72.50 – | 75.00 |
| Barium chloride, bbl. | ton | 87.00 – | 90.00 |
| Barium dioxide, drums | lb. | .18 – | .18½ |
| Barium nitrate, casks | lb. | .08½– | .08¾ |
| Barium sulphate, bbl. | lb. | .04 – | .04½ |
| Blanc fixe, dry, bbl. | lb. | .04 – | .04½ |
| Blanc fixe, pulp, bbl. | ton | 45.00 – | 55.00 |
| Bleaching powder, f.o.b. wks., drums | 100 lb. | 2.20 – | 2.50 |
| Resale drums | 100 lb. | 2.50 – | 2.75 |
| Borax, bbl. | lb. | .05½– | .05¾ |
| Bromine, cases | lb. | .25 – | .27 |
| Calcium acetate, bags | 100 lb. | 3.50 – | 3.60 |
| Calcium carbide, drums | lb. | .04½– | .04¾ |
| Calcium chloride, fused, drums | ton | 22.00 – | 23.00 |
| Gran. drums | lb. | .01½– | .01¾ |
| Calcium phosphate, mono, bbl. | lb. | .06½– | .07 |
| Camphor, cases | lb. | .92 – | .94 |
| Carbon bisulphide, drums | lb. | .07 – | .07½ |
| Carbon tetrachloride, drums | lb. | .09½– | .10 |
| Chalk, precip.—domestic, light, bbl. | lb. | .04½– | .04¾ |
| Domestic, heavy, bbl. | lb. | .03½– | .03¾ |
| Imported, light, bbl. | lb. | .04½– | .05 |
| Chlorine, liquid, cylinders | lb. | .06 – | .06½ |
| Chloroform, tech., drums | lb. | .35 – | .38 |
| Cobalt oxide, bbl. | lb. | 2.10 – | 2.25 |
| Copperas, bulk, f.o.b. wks. | ton | 16.50 – | 20.00 |
| Copper carbonate, bbl. | lb. | .19 – | .20 |
| Copper cyanide, drums | lb. | .47 – | .50 |
| Copper sulphate, crys., bbl., 100 | lb. | 6.40 – | 6.50 |
| Cream of tartar, bbl. | lb. | .24 – | .25 |
| Dextrine, corn, bags | 100 lb. | 3.25 – | 3.50 |
| Epsom salt, dom., tech., bbl. | 100 lb. | 2.00 – | 2.25 |
| Epsom salt, imp., tech., bags | 100 lb. | 1.10 – | 1.25 |
| Epsom salt, U.S.P., dom., bbl. | 100 lb. | 2.50 – | 2.75 |
| Ether, U.S.P., drums | lb. | .13 – | .15 |
| Ethyl acetate, com., 85%, drums | gal. | .80 – | .85 |
| Ethyl acetate, pure (acetic ether, 98% to 100%) | gal. | .95 – | 1.00 |
| Formaldehyde, 40%, bbl. | lb. | $0.15 – | $0.16½ |
| Fullers earth, f.o.b. mines | net ton | 16.00 – | 17.00 |
| Fullers earth—imp., powd., | net ton | 30.00 – | 32.00 |
| Fusel oil, ref., drums | gal. | 3.55 – | 4.05 |
| Fusel oil, crude, drums | gal. | 2.30 – | 2.40 |
| Glaubers salt, wks., bags | 100 lb. | 1.20 – | 1.40 |
| Glaubers salt, imp., bags | 100 lb. | 1.00 – | 1.25 |
| Glycerine, c.p., drums extra | lb. | .18½– | .19 |
| Glycerine, dynamite, drums | lb. | .17 – | .17½ |
| Iodine, resublimed | lb. | 4.55 – | 4.65 |
| Iron oxide, red, casks | lb. | .12 – | .18 |
| Lead: | | | |
| White, basic cabonate, dry, casks | lb. | .10 – | .10½ |
| White, in oil, kegs | lb. | .12½– | .14 |
| Red, dry, casks | lb. | .11½– | .12 |
| Red, in oil, kegs | lb. | .13½– | .15 |
| Lead acetate, white crys., bbl. | lb. | .13 – | .13½ |
| Lead arsenate, powd., bbl. | lb. | .23 – | .24 |
| Lime-Hydrated, bbl. | per ton | 16.80 – | 17.00 |
| Lime, Lump, bbl | 280 lb. | 3.63 – | 3.65 |
| Litharge, comm., casks | lb. | .10½– | .11 |
| Lithophone, bbl. | lb. | .06½– | .07 |
| Magnesium carb., tech., bags | lb. | .08 – | .08½ |
| Methanol, 95%, bbl. | gal. | 1.23 – | 1.25 |
| Methanol, 97%, bbl. | gal. | 1.25 – | 1.27 |
| Nickel salt, double, bbl. | lb. | .10 – | .10½ |
| Nickel salts, single, bbl. | lb. | .11 – | .11½ |
| Phosgene | .... | .60 – | .75 |
| Phosphorus, red, cases | lb. | .35 – | .40 |
| Phosphorus, yellow, cases | lb. | .30 – | .35 |
| Potassium bichromate, casks | lb. | .09¼– | .10 |
| Potassium bromide, gran., bbl. | lb. | .16 – | .23 |
| Potassium carbonate, 80-85%, calcined, casks | lb. | .05½– | .06 |
| Potassium chlorate, powd. | lb. | .07 – | .08 |
| Potassium cyanide, drums | lb. | .45 – | .50 |
| Potassium hydroxide (caustic potash) drums | 100 lb. | 8.00 – | 8.25 |
| Potassium iodide, cases | lb. | 3.65 – | 3.75 |
| Potassium nitrate, bbl. | lb. | .06½– | .07½ |
| Potassium permanganate, drums | lb. | .19½– | .20 |
| Potassium prussiate, red, casks | lb. | .80 – | .85 |
| Potassium prussiate, yellow, casks | lb. | .38 – | .39 |
| Salammoniac, white, gran., casks, imported | lb. | .06½– | .06½ |
| Salammoniac, white, gran., bbl., domestic | lb. | .08 – | .08½ |
| Gray, gran., casks | lb. | .08½– | .08¾ |
| Salsoda, bbl. | 100 lb. | 1.20 – | 1.40 |
| Salt cake (bulk) | ton | 26.00 – | 28.00 |
| Soda ash, light, 58% flat, bags, contract | 100 lb. | 1.60 – | 1.67 |
| Soda ash, light, basis, 48%, bags, contract, f.o.b. wks. | 100 lb. | 1.20 – | 1.30 |
| Soda ash, light, 58%, flat, bags, resale | 100 lb. | 1.75 – | 1.80 |
| Soda ash, dense, bags, contract, basis 48% | 100 lb. | 1.17½– | 1.20 |
| Soda ash, dense, in bags, resale | 100 lb. | 1.85 – | 1.90 |
| Soda, caustic, 76%, solid, drums, f.a.s. | 100 lb. | 3.45 – | 3.70 |
| Soda, caustic, 76%, solid, drums, contract | 100 lb. | 3.35 | 3.40 |
| Soda, caustic, basis 60% wks., contract | 100 lb. | 2.50 – | 2.60 |
| Soda, caustic, ground and flake, contracts | 100 lb. | 3.80 – | 3.90 |
| Soda, caustic, ground and flake, resale | 100 lb. | 4.00 – | 4.15 |
| Sodium acetate, works, bags | lb. | .06 – | .06½ |
| Sodium bicarbonate, bbl. | 100 lb. | 2.00 – | 2.50 |
| Sodium bichromate, casks | lb. | .07½– | .08 |
| Sodium bisulphate (niter cake) | ton | 6.00 – | 7.00 |
| Sodium bisulphite, powd., U.S.P., bbl. | lb. | .04½– | .04½ |
| Sodium chlorate, kegs | lb. | .06½– | .07 |
| Sodium chloride | long ton | 12.00 – | 13.00 |
| Sodium cyanide, cases | lb. | .20 – | .23 |
| Sodium fluoride, bbl. | lb. | .09 – | .10 |
| Sodium hyposulphite, bbl. | lb. | .03 – | .03¼ |
| Sodium nitrite, casks | lb. | .08½– | .09 |
| Sodium peroxide, powd., cases | lb. | .28 – | .30 |
| Sodium phosphate, dibasic, bbl. | lb. | .03½– | .04 |
| Sodium prussiate, yel. drums | lb. | .18½– | .19 |
| Sodium silicate (40°, drums) | 100 lb. | .80 – | 1.15 |
| Sodium silicate (60°, drums) | 100 lb. | 2.00 – | 2.25 |
| Sodium sulphide, fused, 60-62% drums | lb. | .04 – | .04½ |
| Sodium sulphite, crys., bbl. | lb. | .03½– | .03¾ |
| Strontium nitrate, powd., bbl. | lb. | .09½– | .10 |
| Sulphur chloride, yel drums | lb. | .04½– | .05 |
| Sulphur, crude | ton | 18.00 – | 20.00 |
| Sulphur dioxide, liquid, cyl. | lb. | .08 – | .08½ |
| Sulphur, flour, bbl. | 100 lb. | 2.35 – | 3.15 |
| Sulphur, roll, bbl. | 100 lb. | $2.00 – | $2.50 |
| Talc—imported, bags | ton | 30.00 – | 40.00 |
| Talc—domestic powd., bags | ton | 18.00 – | 25.00 |
| Tin bichloride, bbl. | lb. | .11 – | .11½ |
| Tin oxide, bbl. | lb. | .47 – | .48 |
| Zinc carbonate, bags | lb. | .14 – | .14½ |
| Zinc chloride, gran, bbl. | lb. | .06 – | .07 |
| Zinc cyanide, drums | lb. | .37 – | .38 |
| Zinc oxide, XX, bbl. | lb. | .07½– | .08 |
| Zinc sulphate, bbl. | 100 lb. | 2.75 – | 3.00 |

### Coal-Tar Products

| | | | |
|---|---|---|---|
| Alpha-naphthol, crude, bbl. | lb. | $0.80 – | $0.85 |
| Alpha-naphthol, ref., bbl. | lb. | 1.05 – | 1.10 |
| Alpha-naphthylamine, bbl. | lb. | .35 – | .38 |
| Aniline oil, drums | lb. | .16½– | .17 |
| Aniline salts, bbl. | lb. | .24 – | .25 |
| Anthracene, 80%, drums | lb. | .75 – | 1.00 |
| Anthracene, 80%, imp., drums, duty paid | lb. | .65 – | .70 |
| Anthraquinone, 25%, paste, drums | lb. | .70 – | .75 |
| Benzaldehyde U.S.P., carboys | lb. | 1.40 – | 1.45 |
| Benzene, pure, water-white, tanks and drums | gal. | .30 – | .35 |
| Benzene, 90%, tanks & drums | gal. | .26 – | .32 |
| Benzene, 90%, drums, resale | gal. | .33 – | .35 |
| Benzidine base, bbl. | lb. | .85 – | .90 |
| Benzidine sulphate, bbl. | lb. | .75 – | .80 |
| Benzoic acid, U.S.P., kegs | lb. | .72 – | .75 |
| Benzoate of soda, U.S.P., bbl. | lb. | .57 – | .65 |
| Benzyl chloride, 95-97%, ref., drums | lb. | .25 – | .27 |
| Benzyl chloride, tech., drums | lb. | .20 – | .23 |
| Beta-naphthol, subl., bbl. | lb. | .55 – | .60 |
| Beta-naphthol, tech., bbl. | lb. | .24 – | .25 |
| Beta-naphthylamine, tech. | lb. | .80 – | .90 |
| Carbazol, bbl. | lb. | .75 – | .90 |
| Cresol, U.S.P., drums | lb. | .25 – | .29 |
| Ortho-cresol, drums | lb. | .24 – | .26 |
| Cresylic acid, 97%, resale, drums | gal. | 1.50 – | 1.65 |
| 95-97%, drums, resale | gal. | 1.40 – | 1.50 |
| Dichlorbenzene, drums | lb. | .07 – | .09 |
| Diethylaniline, drums | lb. | .50 – | .60 |
| Dimethylaniline, drums | lb. | .41 – | .42 |
| Dinitrobenzene, bbl. | lb. | .19 – | .20 |
| Dinitroclorbenzene, bbl. | lb. | .22 – | .23 |
| Dinitronaphthalene, bbl. | lb. | .30 – | .32 |
| Dinitrophenol, bbl. | lb. | .35 – | .40 |
| Dinitrotoluene, bbl. | lb. | .20 – | .22 |
| Dip oil, 25%, drums | gal. | .25 – | .30 |
| Diphenylamine, bbl. | lb. | .50 – | .52 |
| H-acid, bbl. | lb. | .80 – | .85 |
| Meta-phenylenediamine, bbl. | lb. | .95 – | 1.00 |
| Michlers ketone, bbl. | lb. | 3.00 – | 3.50 |
| Monochlorbenzene, drums | lb. | .08 – | .10 |
| Monoethylaniline, drums | lb. | .95 – | 1.10 |
| Naphthalene, crushed, bbl. | lb. | .05½– | .06 |
| Naphthalene, flake, bbl. | lb. | .06½– | .07 |
| Naphthalene, balls, bbl. | lb. | .07½– | .08 |
| Naphthionate of soda, bbl. | lb. | .58 – | .65 |
| Naphthionic acid, crude, bbl. | lb. | .60 – | .65 |
| Nitrobenzene, drums | lb. | .10 – | .12 |
| Nitro-naphthalene, bbl. | lb. | .30 – | .35 |
| Nitro-toluene, drums | lb. | .15 – | .17 |
| N-W acid, bbl. | lb. | 1.15 – | 1.20 |
| Ortho-amidophenol, kegs | lb. | 2.30 – | 2.35 |
| Ortho-dichlorbenzene, drums | lb. | .17 – | .20 |
| Ortho-nitrophenol, bbl. | lb. | .90 – | .92 |
| Ortho-nitrotoluene, drums | lb. | .10 – | .12 |
| Ortho-toluidine, bbl. | lb. | .13 – | .15 |
| Para-amidophenol, base, kegs | lb. | 1.15 – | 1.20 |
| Para-amidophenol, HCl, kegs | lb. | 1.20 – | 1.25 |
| Para-dichlorbenzene, bbl. | lb. | .17 – | .20 |
| Paranitraniline, bbl. | lb. | .74 – | .75 |
| Para-nitrotoluene, bbl. | lb. | .55 – | .65 |
| Para-phenylenediamine, bbl. | lb. | 1.45 – | 1.50 |
| Para-toluidine, bbl. | lb. | .90 – | .95 |
| Phthalic anhydride, bbl. | lb. | .35 – | .38 |
| Phenol, U.S.P., drums | lb. | .45 – | .50 |
| Picric acid, bbl. | lb. | .20 – | .22 |
| Pyridine, dom., drums | gal. | nominal | |
| Pyridine, imp., drums | gal. | 2.30 – | 2.50 |
| Resorcinol, tech., kegs | lb. | 1.50 – | 1.55 |
| Resorcinol, pure, kegs | lb. | 2.00 – | 2.10 |
| R-salt, bbl. | lb. | .60 – | .65 |
| Salicylic acid, tech., bbl. | lb. | .40 – | .42 |
| Salicylic acid, U.S.P., bbl. | lb. | .45 – | .47 |
| Solvent naphtha, water-white, drums | gal. | .37 – | .40 |
| Crude, drums | gal. | .22 – | .24 |
| Sulphanilic acid, crude, bbl. | lb. | .18 – | .20 |
| Thiocarbanilide, kegs | lb. | .35 – | .38 |
| Toluidine, kegs | lb. | 1.20 – | 1.30 |
| Toluidine, mixed, kegs | lb. | .30 – | .35 |
| Toluene, tank cars | gal. | .35 – | .37 |
| Toluene, drums | gal. | .40 – | .43 |
| Xylidines, drums | lb. | .40 – | .45 |
| Xylene, pure, drums | gal. | .45 – | .50 |
| Xylene, com., drums | gal. | .40 – | .42 |
| Xylene, com., tanks | gal. | .30 – | ..... |

## Naval Stores

| | | | |
|---|---|---|---|
| Rosin B-D, bbl. | 280 lb. | $6.10 – | |
| Rosin E-I, bbl. | 280 lb. | 6.20 – | $6.35 |
| Rosin K-N, bbl. | 280 lb. | 6.50 – | 6.90 |
| Rosin W.G.-W.W., bbl. | 280 lb. | 7.35 – | 8.05 |
| Wood rosin, bbl. | 280 lb. | 6.25 – | |
| Turpentine, spirits of, bbl. | gal. | 1.52 – | 1.53 |
| Wood, steam dist., bbl. | gal. | 1.35 – | |
| Wood, dest. dist., bbl. | gal. | 1.25 – | |
| Pine tar pitch, bbl. | 200 lb. | – | 6.00 |
| Tar, kiln burned, bbl. | 500 lb. | – | 12.00 |
| Retort tar, bbl. | 500 lb. | – | 11.00 |
| Rosin oil, first run, bbl. | gal. | .43 – | |
| Rosin oil, second run, bbl. | gal. | .47 – | |
| Rosin oil, third run, bbl. | gal. | .53 – | |
| Pine oil, steam dist. | gal. | – | .90 |
| Pine oil, pure, dest. dist. | gal. | – | .85 |
| Pine tar oil, ref. | gal. | – | .46 |
| Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla. | gal. | – | .35 |
| Pine tar oil, double ref., bbl. | gal. | – | .75 |
| Pine tar, ref., thin, bbl. | gal. | – | .25 |
| Pinewood creosote, ref., bbl. | gal. | – | .52 |

## Vegetable Oils

| | | | |
|---|---|---|---|
| Castor oil, No. 3, bbl. | lb. | $.12½– | $.13 |
| Castor oil, AA, bbl. | lb. | .13¼– | .13½ |
| Chinawood oil, bbl. | lb. | .18 – | .19 |
| Coconut oil, Ceylon, bbl. | lb. | .09½ – | .9¾ |
| Coconut oil, Cochin, bbl. | lb. | .09¾ – | .10 |
| Corn oil, crude, bbl. | lb. | .12 – | .12½ |
| Cottonseed oil, crude (f.o.b. mill), tanks | lb. | .10 – | .10 |
| Summer yellow, bbl. | lb. | .12 – | .12½ |
| *Winter yellow, bbl. | lb. | .13 – | .13½ |
| Linseed oil, raw, car lots, bbl. | gal. | .98 – | .99 |
| Raw, tank cars (dom.) | gal. | .94 – | .95 |
| Boiled, 5-bbl. lots (dom.) | gal. | 1.02 – | 1.04 |
| Olive oil, denatured, bbl. | gal. | 1.10 – | 1.15 |
| Palm, Lagos, casks | lb. | .08½– | .08½ |
| Palm kernel, bbl. | lb. | .08½– | .09 |
| Peanut oil, crude, tanks (mill) | lb. | .13½– | .13½ |
| Peanut oil, refined, bbl. | lb. | .16½– | .16½ |
| Rapeseed oil, refined, bbl. | gal. | .85 – | .86 |
| Rapeseed oil, blown, bbl. | gal. | .90 – | .91 |
| Soya bean (Manchurian), bbl. | lb. | .12 – | |
| Tank, f.o.b. Pacific coast | lb. | .10½– | |

## Fish Oils

| | | | |
|---|---|---|---|
| Menhaden, light pressed, bbl. | gal. | $0.68 – | .70 |
| White bleached, bbl. | gal. | .72 – | .74 |
| Blown, bbl. | gal. | .76 – | .78 |
| Whale No. 1 crude, tanks, coast | lb. | .06 – | .06½ |

## Dye & Tanning Materials

| | | | |
|---|---|---|---|
| Divi-divi, bags | ton | $38.00 – | $39.00 |
| Fustic, sticks | ton | 30.00 – | 35.00 |
| Fustic, chips, bags | lb. | .04 – | .05 |
| Logwood, sticks | ton | 28.00 – | 30.00 |
| Logwood, chips, bags | lb. | .02½– | .03½ |
| Sumac, leaves, Sicily, bags | ton | 65.00 – | |
| Sumac, ground, bags | ton | 55.00 – | 60.00 |
| Sumac, domestic, bags | ton | 35.00 – | |
| Tapioca flour, bags | lb. | .03¼– | .05 |
| EXTRACTS | | | |
| Archil, conc., bbl. | lb. | $0.17 – | $0.18 |
| Chestnut, 25% tannin, tanks | lb. | .02 – | .03 |
| Divi-divi, 25% tannin, bbl. | lb. | .04 – | .05 |
| Fustic, crystals, bbl. | lb. | .20 – | .22 |
| Fustic, liquid, 42°, bbl. | lb. | .08 – | .09 |
| Gambier, liq., 25% tannin, bbl. | lb. | .08 – | .09 |
| Hematine crys., bbl. | lb. | .14 – | .18 |
| Hemlock, 25% tannin, bbl. | lb. | .04 – | .05 |
| Hypernic, solid, drums | lb. | .24 – | .26 |
| Hypernic, liquid, 51°, bbl. | lb. | .14 – | .17 |
| Logwood, crys., bbl. | lb. | .19 – | .20 |
| Logwood, liq., 51°, bbl. | lb. | .09 – | .10 |
| Quebracho, solid, 65% tannin, bbl. | lb. | .04½– | .05 |
| Sumac, dom., 51°, bbl. | lb. | .06½– | .07 |

## Waxes

| | | | |
|---|---|---|---|
| Bayberry, bbl. | lb. | $0.28 – | $0.30 |
| Beeswax, refined, dark, bags | lb. | .30 – | .32 |
| Beeswax, refined, light, bags | lb. | .34 – | .35 |
| Beeswax, pure white, cases | lb. | .40 – | .41 |
| Candellila, bags | lb. | .27 – | .29 |
| Carnauba, No. 1, bags | lb. | .40 – | .41 |
| No. 2, North Country, bags | lb. | .23½– | .24 |
| No. 3, North Country, bags | lb. | .19 – | .19½ |
| Japan, cases | lb. | .15 – | .15½ |
| Montan, crude, bags | lb. | .03½– | .04 |
| Paraffine, crude, match, 105-110 m.p. | lb. | .04 – | .04½ |
| Crude, scale 124-126 m.p., bags | lb. | .02½– | .02¾ |
| Ref., 118-120 m.p., bags | lb. | .03½– | .03¾ |
| Ref., 125 m.p., bags | lb. | .03¾– | .03¾ |
| Ref. 128-130 m.p., bags | lb. | .04 – | .04¼ |
| Ref., 133-135 m.p., bags | lb. | .04¼– | .04½ |
| Ref., 135-137 m.p., bags | lb. | .05 – | .05¼ |
| Stearic acid, agle pressed, bags | lb. | .10 – | .10½ |
| Double pressed, bags | lb. | .10½– | .10¾ |
| Triple pressed, bags | lb. | .11 – | .11½ |

## Fertilizers

| | | | |
|---|---|---|---|
| Ammonium sulphate, bulk, f.o.b. works | 100 lb. | $3.20 – | $3.25 |
| F.a.s. double bags | 100 lb. | 3.85 – | 3.95 |
| Blood, dried, bulk | unit | 4.60 – | |
| Bone, raw, 3 and 50, ground | ton | 30.00 – | 35.00 |
| Fish scrap, dom., dried, wks. | unit | 5.00 – | 5.10 |
| Nitrate of soda, bags | 100 lb. | 2.60 – | 2.65 |
| Tankage, high grade, f.o.b. Chicago | unit | 4.70 – | 4.80 |
| Phosphate rock, f.o.b. mines, Florida pebble, 68-72% | ton | $4.00 – | $4.50 |
| Tennessee, 78-80% | ton | 8.00 – | 8.25 |
| Potassium muriate, 80%, bags | ton | 35.00 – | 36.00 |
| Potassium sulphate, bags | unit | 1.00 – | |

## Crude Rubber

| | | | |
|---|---|---|---|
| Para—Upriver fine | lb. | $0.33 – | $0.33½ |
| Upriver coarse | lb. | .27½– | .28 |
| Upriver caucho ball | lb. | .29½– | .30 |
| Plantation—First latex crepe | lb. | .36½– | .36½ |
| Ribbed smoked sheets | lb. | .36½– | .36½ |
| Brown crepe, thin, clean | lb. | .31 – | .32 |
| Amber crepe No. 1 | lb. | .31 – | .32 |

## Miscellaneous Materials

| | | | |
|---|---|---|---|
| Asbestos, crude No. 1, f.o.b., Quebec | sh. ton | $450.00 – | $550.00 |
| Asbestos, shingle, f.o.b., Quebec | sh. ton | 60.00 – | 80.00 |
| Asbestos, cement, f.o.b., Quebec | sh. ton | 15.00 – | 17.00 |
| Barytes, grd., white, f.o.b. mills, bbl. | net ton | 16.00 – | 20.00 |
| Barytes, grd., off-color, f.o.b. mills bulk | net ton | 13.00 – | 15.00 |
| Barytes, floated, f.o.b. St. Louis, bbl. | net ton | 24.00 – | 28.00 |
| Barytes, crude f.o.b. mines, bulk | net ton | 9.00 – | 9.25 |
| Casein, bbl., tech. | lb. | .11 – | .12 |
| China clay (kaolin) crude, f.o.b. Ga. | net ton | 7.00 – | 9.00 |
| Washed, f.o.b. Ga. | net ton | 8.00 – | 9.00 |
| Powd., f.o.b. Ga. | net ton | 13.00 – | 20.00 |
| Crude f.o.b. Va. | net ton | 8.00 – | 12.00 |
| Ground, f.o.b. Va. | net ton | 13.00 – | 20.00 |
| Imp., lump, bulk | net ton | 15.00 – | 20.00 |
| Imp., powd. | net ton | 45.00 – | 50.00 |
| Feldspar, No. 1 pottery | long ton | 6.00 – | 7.00 |
| No. 2 pottery | long ton | 5.00 – | 5.50 |
| No. 1 soap | long ton | 7.00 – | 7.50 |
| No. 1 Canadian, f.o.b. mill | long ton | 25.00 – | 27.00 |
| Graphite, Ceylon, lump, first quality, bbl. | lb. | .06 – | .06½ |
| Ceylon, chip, bbl. | lb. | .05 – | .05½ |
| High grade amorphous crude | ton | 35.00 – | 50.00 |
| Gum arabic, amber, sorts, bags | lb. | .15 – | .16 |
| Gum tragacanth, sorts, bags | lb. | .50 – | .60 |
| No. 1, bags | lb. | 1.75 – | 1.80 |
| Kieselguhr, f.o.b. Cal. | ton | 40.00 – | 42.00 |
| F.o.b. N.Y. | ton | 50.00 – | 55.00 |
| Magnesite, crude, f.o.b. Cal. | ton | 14.00 – | 15.00 |
| Pumice stone, imp., casks | lb. | .03 – | .05½ |
| Dom., lump, bbl. | lb. | .05 – | .05½ |
| Dom., ground, bbl. | lb. | .06 – | .07 |
| Shellac, orange fine, bags | lb. | .82 – | .83 |
| Orange superfine, bags | lb. | .84 – | .85 |
| A. C. garnet, bags | lb. | .79 – | .80 |
| T. N., bags | lb. | .80 – | .81 |
| Silica, glass sand, f.o.b. Ind. | ton | 2.00 – | 2.50 |
| Silica, sand blast, f.o.b. Ind. | ton | 2.50 | 5.00 |
| Silica, amorphous, 250-mesh, f.o.b. Ill. | ton | 17.00 – | 17.50 |
| Silica, bldg. sand, f.o.b. Pa. | ton | 2.00 – | 2.75 |
| Soapstone, coarse, f.o.b. Vt., bags | ton | 7.00 – | 8.00 |
| Talc, 200 mesh, f.o.b., Vt., bags | ton | 6.50 – | 9.00 |
| Talc, 200 mesh, f.o.b. Ga., bags | ton | 7.00 – | 9.00 |
| Talc, 200 mesh, f.o.b. Los Angeles, bags | ton | 16.00 – | 20.00 |

## Refractories

| | | |
|---|---|---|
| Bauxite brick, 56% $Al_2O_3$, f.o.b. Pittsburgh | ton | $45–50 |
| Chrome brick, f.o.b. Eastern shipping points | ton | 50–52 |
| Chrome cement, 40-50% $Cr_2O_3$ | ton | 23–27 |
| 40-45% $Cr_2O_3$, sacks, f.o.b. Eastern shipping points | ton | 23.00 |
| Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks. | 1,000 | 40–46 |
| 2nd. quality, 9-in. shapes, f.o.b. wks. | 1,000 | 36–41 |
| Magnesite brick, 9-in. straight (f.o.b. wks.) | ton | 65–68 |
| 9-in. arches, wedges and keys | ton | 80–85 |
| Scraps and splits | ton | 85 |
| Silica brick, 9-in. sizes, f.o.b. Chicago district | 1,000 | 48–50 |
| Silica brick, 9-in. sizes, f.o.b. Birmingham district | 1,000 | 48–50 |
| F.o.b. Mt. Union, Pa. | 1,000 | 42–44 |
| Silicon carbide refract. brick, 9-in. | 1,000 | 1,100.00 |

## Ferro-Alloys

| | | | |
|---|---|---|---|
| Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N.Y. | ton | $200.00 – | $225.00 |
| Ferrochromium, per lb. of Cr, 6-8% C | lb. | .11½ | .11¾ |
| 4-6% C | lb. | .12 – | .13 |
| Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid | gr. ton | 110.00 – | 112.00 |
| Spiegeleisen, 19-21% Mn. | gr. ton | 35.00 – | 37.00 |
| Ferromolybdenum, 50-60% Mo, per lb Mo | lb. | 1.90 – | 2.15 |
| Ferrosilicon, 10-15% | gr. ton | 38.00 – | 40.00 |
| 50% | gr. ton | 80.00 – | 85.00 |
| 75% | gr. ton | 150.00 – | 160.00 |
| Ferrotungsten, 70-80%, per lb. of W | lb. | $0.85 – | $0.90 |
| Ferro-uranium, 35-50% of U. per lb. of U | lb. | 6.00 – | |
| Ferrovanadium, 30-40%, per lb. of V | lb. | 3.75 – | 4.00 |

## Ores and Semi-finished Products

| | | | |
|---|---|---|---|
| Bauxite, dom. crushed, dried, f.o.b. shipping points | ton | $6.50 – | $8.75 |
| Chrome ore, Calif. concentrates, 50% min. $Cr_2O_3$ | ton | 22.00 – | 23.00 |
| C.i.f. Atlantic seaboard | ton | 18.50 – | 19.00 |
| Coke, fdry., f.o.b. ovens | ton | 8.25 – | 8.50 |
| Coke, furnace, f.o.b. ovens | ton | 7.00 – | 7.25 |
| Fluorspar, gravel, f.o.b. mines' Illinois | ton | 21.50 – | |
| Ilmenite, 52% $TiO_2$ | lb. | .01½– | .01¾ |
| Manganese ore, 50% Mn, c.i.f. Atlantic seaport | unit | .33 – | |
| Manganese ore, chemical ($MnO_2$) | ton | 75.00 – | 80.00 |
| Molybdenite, 85% $MoS_2$, per lb. $MoS_2$, N.Y. | lb. | .65 – | .70 |
| Monazite, per unit of $ThO_2$, c.i.f., Atl. seaport | lb. | .06 – | .08 |
| Pyrites, Span., fines, c.i.f. Atl. seaport | unit | .11½– | .12 |
| Pyrites, Span., furnace size, c.i.f. Atl. seaport | unit | .11½– | .12 |
| Pyrites, dom. fines, f.o.b. mines, Ga. | unit | .12 | |
| Rutile, 95% $TiO_2$ | lb. | .12 – | |
| Tungsten, scheelite, 60% $WO_3$ and over, per unit $WO_3$ | unit | 8.50 – | 8.75 |
| Tungsten, wolframite, 60% $WO_3$ and over, per unit $WO_3$ | unit | 8.00 – | 8.25 |
| Uranium ore (carnotite) per lb. of $U_3O_8$ | lb. | 3.50 – | 3.75 |
| Uranium oxide, 96% per lb. $U_3O_8$ | lb. | 2.25 – | 2.50 |
| Vanadium pentoxide, 99% | lb. | 12.00 – | 14.00 |
| Vanadium ore, per lb. $V_2O_5$ | lb. | 1.00 – | |
| Zircon, washed, iron free, f.o.b. Pablo, Fla. | lb. | .04½– | .13 |

## Non-Ferrous Materials

| | Cents per Lb. |
|---|---|
| Copper, electrolytic | 16.75 |
| Aluminum, 98 to 99% | 24.00 |
| Antimony, wholesale, Chinese and Japanese | 7.65–7.75 |
| Nickel, virgin metal | 25.00–27.00 |
| Nickel, ingot and shot | 29.00 |
| Monel metal, shot and blocks | 32.00 |
| Monel metal, ingots | 38.00 |
| Monel metal, sheet bars | 45.00 |
| Tin, 5-ton lots, Straits | 46.75 |
| Lead, New York, spot | 8.15 |
| Lead, E. St. Louis, spot | 8.20 |
| Zinc, spot, New York | 7.90–8.00 |
| Zinc, spot, E. St. Louis | 7.60–7.70 |

### OTHER METALS

| | | |
|---|---|---|
| Silver (commercial) | oz. | $0.66¾ |
| Cadmium | lb. | 1.15 |
| Bismuth (500 lb. lots) | lb. | 2.55 |
| Cobalt | lb. | 2.65@2.85 |
| Magnesium, ingots, 99% | lb. | 1.00@1.05 |
| Platinum | oz. | 110.00 |
| Iridium | oz. | 260.00@275.00 |
| Palladium | oz. | 79.00 |
| Mercury | 75 lb. | 70.00 |

### INISHED METAL PRODUCTS

| | Warehouse Price Cents per Lb. |
|---|---|
| Copper sheets, hot rolled | 20.75 |
| Copper bottoms | 30.75 |
| Copper rods | 20.50 |
| High brass wire | 19.50 |
| High brass rods | 17.00 |
| Low brass wire | 21.10 |
| Low brass rods | 22.00 |
| Brazed brass tubing | 24.25 |
| Brazed bronze tubing | 29.00 |
| Seamless copper tubing | 25.25 |
| Seamless high brass tubing | 23.50 |

**OLD METALS**—The following are the dealers' purchasing prices in cents per pound:

| | |
|---|---|
| Copper, heavy and crucible | 11.30@11.50 |
| Copper, heavy and wire | 11.25@11.50 |
| Copper, light and bottoms | 9.25@ 9.50 |
| Lead, heavy | 5.75@ 6.00 |
| Lead, tea | 3.50@ 3.75 |
| Brass, heavy | 6.25@ 6.40 |
| Brass, light | 5.35@ 5.75 |
| No. 1 yellow brass turnings | 6.30@ 6.50 |
| Zinc | 3.50@ 4.00 |

## Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

| | New York | Chicago |
|---|---|---|
| Structural shapes | $3.29 | $3.14 |
| Soft steel bars | 3.19 | 3.04 |
| Soft steel bar shapes | 3.19 | 3.04 |
| Soft steel bands | 3.29 | 3.19 |
| Plates, ¼ to 1 in. thick | 3.29 | 3.14 |

# Industrial

## Financial. Construction and Manufacturers' News

## Construction and Operation

### Alabama

GADSDEN—The Agricola Pipe Co., recently organized with a capital of $250,000, operating a plant at Anniston, Ala., for the manufacture of cast-iron pipe, has acquired the Campbell Co., with foundry on North 3rd St. The new owner will take possession of the property at once and purposes to make a number of improvements. It will be run for the production of cast-iron soil pipe. Otto Agricola is president; and Fred T. Agricola, secretary and treasurer.

ATMORE—The Cooper & Bannon Co., Oak Grove, Ala., has acquired a large tract of local property, heretofore held by the Pine Barren Mill Co., and plans for the establishment of a new plant for the production of turpentine.

### California

SAN LUIS OBISPO—The United States Refractories Co. is planning for enlargements in its plant to cost about $60,000, including the construction of two new kilns. The company specializes in the manufacture of insulated brick, insulation powders, firebrick, etc. R. W. Hull, Sr., and J. H. Throop are heads.

GAVIOTA—Fire, Feb. 17, destroyed a large portion of the storage and distributing plant of the Associated Oil Co., with loss reported in excess of $750,000, including equipment. It is planned to rebuild. Headquarters of the company are in the Sharon Bldg., San Francisco.

MARYSVILLE—The Marysville Brick Co. has plans under way for additions to its plant to double approximately the present capacity, providing an annual output of close to 4,000,000 bricks. New electric-operated machinery will be installed. L. A. Williams is president.

LOS ANGELES—The Southwestern Shipbuilding Co., San Pedro, Los Angeles Harbor, has plans in progress for the construction of a new oil storage and distributing plant for company service, estimated to cost $300,000, with equipment.

OAKLAND—A porcelain- and metal-enameling plant will be installed at the new local factory of the Koken Companies, Texas St., St. Louis, Mo., now in course of construction. The company manufactures barber chairs and kindred equipment. The new works are expected to be ready for service in about 60 days. Walter F. Koken is president.

### Florida

HASTINGS—The Truman Fertilizer Co. has plans in progress for the erection of a new 1-story building at its plant.

### Georgia

BUFORD—The Bone Allen Co., Inc., manufacturer of leather products, has work under way on extensions at its tanning plant for considerable increase in production, to include the installation of 200 new tanning vats and auxiliary equipment. Additions will also be made in the power department at the plant. Lockwood, Greene & Co., Atlanta, Ga., are engineers.

### Illinois

CHICAGO—The Inland Steel Co., 38 South Dearborn St., has plans under consideration for enlargements in its works at Indiana Harbor, Ind., to include new open-hearth furnaces, finishing mills and other structures. It is purposed to increase the capacity about one-fourth, with heavier increase in the department devoted to the production of different grades of light steel. A preferred stock issue is being arranged to provide funds for the expansion.

CARLYLE—The Common Council has completed plans for the installation of a new filtration and purification plant at the municipal waterworks, and a call for bids on general contract has been issued. Dawson & Walraven, Springfield, Ill., are engineers.

CHICAGO—The Marquette Cement Co., 140 South Dearborn St., is taking bids on a general contract for the erection of a new 1-story building, 175x500 ft. at Elston and Redfield Aves., estimated to cost about $250,000. L. E. Ritter, Room 1707, 140 South Dearborn St., is engineer.

### Indiana

JEFFERSONVILLE—The Interstate Public Service Co. will make extensions in its local artificial gas plant to increase the capacity about 300,000 cu.ft. per day. A new water-gas set and auxiliary equipment will be installed. It is purposed to have the work completed early in June.

### Kansas

EUREKA—The Kansas City Refining Co., 1st Ave., Kansas City, Mo., is considering tentative plans for the construction of a new oil-refining plant in the vicinity of Eureka, estimated to cost close to $200,000. The project will be held in temporary abeyance until full field development for crude petroleum has been attained. E. W. Goebel is in charge.

### Kentucky

CARTER—The Ashland Limestone Co. has perfected arrangements for the installation of a new crushing plant, with auxiliary operating departments, to develop a capacity of 3,000 tons per day. The plant will be located at Rock Crusher, near Carter. M. E. S. Posey is general manager.

### Louisiana

BOGALUSA—The Great Southern Lumber Co., operating a local saw and lumber mill, will commence the construction of a branch works for the production of byproducts, including turpentine, pine oils and resin. Two processes of operation will be installed, covering the dry kiln and steaming method, and special treatment of resin timber picked from the green chain, respectively. It is purposed to have the branch plant ready for service in about 4 months.

### Maryland

BALTIMORE—The Fourlock Tile Co., Candler Bldg., Market Place and Pratt St., has acquired a building formerly occupied by the General Minerals Co., vicinity of the Union Stock Yards, for a new plant for the manufacture of special interlocking concrete tile. Machinery and operating equipment will be installed at once to develop an initial capacity of about 1,000 tile daily; this output will be increased early in the spring. Tentative plans are under consideration for the establishment of branch plants at Hagerstown, Cumberland and Easton, Md. Frank H. Carter is secretary. The company was organized recently with a capital of $100,000.

### Massachusetts

CHICOPEE—The Moore Drop Forge Co., Walter St., Springfield, Mass., has awarded a contract to Adams & Ruxton, Springfield, for the erection of a new 1-story building at its Chicopee Works, 75x100 ft., to be equipped as a heat-treating department. It is estimated to cost close to $70,000, including machinery. McClintock & Craig, 33 Lyman St., Springfield, are engineers.

BOSTON—The Crescent Tanning Co. has leased a floor in the building at 105 South St., for a new works. Immediate operations are planned.

### Michigan

GRAND RAPIDS—The Grand Rapids Glass Co. has purchased property, 125x150 ft., at Fulton St. and Front Ave., for the erection of a new plant. Plans will be prepared at an early date.

JACKSON—The Grand Rapids Paint & Varnish Co. has plans under consideration for the erection of an addition to the local plant of the Central City Paint & Varnish Co., recently acquired. A project is also being discussed covering the construction of an entirely new works to replace the present factory, which is of old type. Alfred Hansen is resident manager.

MUSKEGON—The Brunswick-Balke-Collender Co., 629 South Wabash Ave., Chicago, Ill., has tentative plans under consideration for the rebuilding of the portion of its celluloid plant at Muskegon, recently destroyed by fire with loss estimated at $200,000, including machinery.

DETROIT—Roehm & Davison, 6440-52 Mack Ave., manufacturers of steel products, have awarded a general contract to Everett Winters, Book Bldg., for the erection of a 2-story plant addition at Mack and Beaufaite Aves., 150x152 ft., estimated to cost approximately $100,000, with equipment.

PLAINWELL—The Angle Steel Stool Co. has tentative plans under consideration for the erection of an addition to its plant.

### Mississippi

MOSS POINT—The Southern Paper Co. has awarded a general contract to George J. Glover, Whitney Central Bldg., New Orleans, La., for the construction of its proposed plant additions, covering an area of about 75x800 ft., varying from 1 story to 5 stories high. The extensions will double approximately the present plant output and are estimated to cost close to $1,500,000 with machinery. A power plant will also be built. The work will be placed under way at once. George F. Hardy, 309 Broadway, New York, N. Y., is engineer.

### Nevada

GOLDFIELD—The Bellehelen Merger Mines Co. has construction under way on a new mill at its local properties, to have a rating of 100 tons a day. It is estimated to cost approximately $125,000. The company is also arranging for extensive development work, to include the installation of additional equipment. The Wellington Mines Co., Kansas City, Mo., is interested in the Bellehelen company.

### New Jersey

STOCKTON—The Tillinghast Rubber Mfg. Co., manufacturer of rubber tubing and specialties, is planning for the rebuilding of the portion of its local mill, destroyed by fire, Feb. 16, with loss approximating $100,000, including machinery. The equipment installation was valued in excess of $30,000. Walker Smith is president; and William J. McLaughlin, secretary.

BELLEVILLE — Daniel H. Higgins, Edgewater, N. J., manufacturer of dyes and kindred chemical products, has taken title to the former plant of the Thomson Machine Co., Main St., Belleville, consisting of three factory buildings on a half-acre tract of land, with aggregate of 20,000 sq.ft. of floor space. Plans are under way for the establishment of a new dye and chemical works at this location.

BLOOMSBURY—The Bloomsbury Graphite Co. has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, Feb. 20, with loss estimated at $40,000, including equipment. The company manufactures graphite products, foundry facing, etc.

NEWARK—The Hamilton Tanning Co. has leased property at Wright St. and Ave. A for a term of years, comprising a 1-story building 125 ft. long, for the establishment of a new leather tannery. Immediate possession will be taken.

CAMDEN—Fire, Feb. 20, destroyed a portion of the chemical plant of the Mechling Brothers Mfg. Co., Line St. and Cooper River, South Camden. It originated in the sulphur department. An official estimate of the loss has not been announced. Plans are under consideration for immediate rebuilding.

### New Mexico

SANTA FE—The Navajo Gasoline Production Co. is planning for the construction of gasoline extraction plants in the San Juan basin district.

### New York

NEW YORK—The Consolidated Products Co., Inc., 15 Park Row, New York, has inquiries out for equipment for installation in a chemical plant, including disintegrators, filter presses, driers, evaporators, grinding machinery and kindred machinery.

ROME—The Rome Brass & Copper Co. has taken bids on a general contract for the erection of a new building at its Chicago, Ill., works, to be 1-story and basement,

50x180 ft., estimated to cost approximately $50,000. M. K. Williams is in charge.

## Ohio

SEBRING—The French China Co. is planning for the early erection of an addition to its plant, including the installation of two new pottery kilns.

CAMBRIDGE—The Cambridge Steel Products Co., recently organized with a capital of $100,000, will take over and operate the local plant of the Cambridge Steel Co. Possession will be taken at once. Extensions and improvements are contemplated.

SEBRING—The Saxon China Co. has preliminary plans under consideration for enlargements in its plant, to include the construction of three new kilns. It is purposed to increase the output about one-third.

CAMBRIDGE—Interests which recently acquired the plant of the Guernseyware China Co. are perfecting arrangements for the early resumption of operations for the manufacture of a line of hotel chinaware. Improvements will be made in the plant and equipment for this service.

## Oklahoma

TULSA—The Union Carbide Co., 30 East 42nd St., New York, N. Y., manufacturer of carbide, acetylene, commercial oxygen and kindred products, is said to be planning for the erection of a new plant in the vicinity of Tulsa, estimated to cost close to $350,000, with machinery.

## Pennsylvania

READING—The Pennsylvania Electric Steel Co. has acquired the local plant of the Driscoll-Rees Steel Co. and plans to equip and utilize the property for the production of high-grade tool steel, to be produced by means of a new process. It is purposed to have the plant in full operation at an early date.

CHAMBERSBURG—The Chambersburg Gas Co. will make improvements and extensions in its artificial gas plant, with additional equipment installation estimated to cost about $60,000. Contracts are being let.

PITTSBURGH—The Pennsylvania Paper Stock Co., 516-26 1st Ave., has tentative plans under consideration for the rebuilding of the portion of its plant, destroyed by fire, Feb. 18, with loss estimated at close to $75,000.

PHILADELPHIA—Fire, Feb. 17, destroyed a portion of the acid works of the Wilson-Martin Co., Snyder Ave. and Swanson St., with loss estimated at $12,000. It will be rebuilt.

PHILADELPHIA—The Precision Grinding Wheel Co., 8301 Torresdale Ave., has filed plans for the erection of a new 1-story building at its plant.

CONSHOHOCKEN—A 1-story foundry, 125x195 ft., will be erected by the Montgomery Foundry & Fittings Co., located at Washington and Cherry Sts., for the production of iron and other metal castings. Work will be commenced early in April.

LEBANON—The Lebanon Iron Co. is planning for the immediate rebuilding of its puddle mill and adjoining buildings, destroyed by fire, Feb. 18, with loss estimated at close to $150,000, including ten furnaces and auxiliary equipment. John D. Brown is general manager at the plant.

BATH—The Pocono Foundry Co. has tentative plans under consideration for extensions and improvements in its plant.

## Tennessee

CHATTANOOGA—The Southern Sheet Steel Co., recently organized with a capital of $1,100,000, is perfecting plans for the erection of its proposed new mills at Glendale, Tenn., where a site has been secured on the Tennessee River. The initial works will comprise two open-hearth furnaces, each with rated capacity of 60,000 tons per annum; a number of rolling mills, with total annual output of 55,000 tons and other miscellaneous mill and sheet mill buildings, with power house. The plant is estimated to cost close to $80,000. W. J. Lynch is vice-president and general manager.

## Texas

AUSTIN—A chemical laboratory will be installed in the new biology building to be constructed on the campus, University of Texas. The structure will be 3-story, 66x191 ft., and will cost in excess of $250,000. Herbert M. Greene, Dallas, Tex., is architect.

## Virginia

SUFFOLK—The American Brick Corp. will commence immediately the erection of a new plant on local site, to be equipped for an initial capacity of 25,000 to 30,000 bricks per day. It is estimated to cost approximately $35,000. R. L. Jacobs is president; and Lewis G. Brothers, secretary.

NORFOLK—Adolph Segal, Philadelphia, Pa., sugar operator, is perfecting plans for the construction and operation of a new sugar refinery on site secured at Norfolk. It will consist of a number of buildings with power house, and is estimated to cost in excess of $3,000,000, with machinery. It is expected to develop an output of close to 3,000 bbl. of refined sugar daily. Charles B. Hughes, president of the Hughes-Ellis-Howell Corp., 403 Boush St., Norfolk, is interested in the project.

NORTON—L. A. Ballenby, Norton, is organizing a company to construct and operate a local plant for the manufacture of brick and tile products. Work will soon be commenced.

## Washington

NEWPORT—The Pacific Fir Co. has plans under way for the construction of a new creosoting and wood-treatment plant on local site, estimated to cost approximately $25,000.

SEATTLE—The Guilders Brick Co., 3700 9th St., South, will make improvements in its plant, including the construction of a new kiln.

VANCOUVER—The Columbia River Paper Mills Co. is perfecting plans for the construction of the initial unit of its proposed new mill, estimated to cost in excess of $200,000, with machinery. F. W. Leadbeater is president.

## Wisconsin

NEENAH—The Valley Paper Mills, Inc., Wisconsin Ave., will take bids about March 15 for the erection of the superstructure of its proposed new mill in the Blair Springs district, foundations for which have been laid. The plant will be 2- and 3-story, 80x670 ft., and is estimated to cost $750,000, including machinery. Cahill & Douglas, 217 West Water St., Milwaukee, are mechanical engineers for the work. G. W. Burnside is head.

# Industrial Developments

RUBBER—The Kelly-Springfield Tire Co. is operating at full capacity at its plants at Akron, O., and Cumberland, Md., and will maintain this schedule for an indefinite period. The last noted mill is now giving employment to about 2,500 persons, and plans are under way for early expansion. Effective Feb. 21, the wages at the mill were advanced 10 per cent, affecting all hourly rates and piece-work production.

The Atlas Automobile Tire Co., Bethlehem, Pa., is running at maximum capacity, and in order to handle heavy incoming business plans are being arranged for extensions in the mill facilities.

The Mason Tire & Rubber Co., Akron, O., is operating at full capacity, on a basis of about 6,000 tires per day. Full production is also being maintained at the branch mill at Bedford, O., formerly occupied by the Owen Tire & Rubber Co.

CERAMIC—The Verdigris Valley Vitrified Brick Co., Independence, Kan., recently acquired by new interests, is planning for the early resumption of production at the plant, now closed down for machinery repairs. W. E. Bullis, Topeka, Kan.; and M. B. Gilkerson, Wichita, Kan., head the new organization.

General ware plants in the vicinity of East Liverpool, O., are running full, with incoming orders in excess of immediate production.

The Independent Brick Co., Trenton, N. J., is maintaining operations at regular capacity at three of its four plants. It is expected to continue on this basis for an indefinite period. Charles T. Dunham has been re-elected secretary, treasurer and general manager of the company.

The Crouse Clay Products Co., Akron, O., is maintaining full production at its plant and purposes to continue on this status for some time to come. The company has recently installed new machinery and equipment to provide for an advance of about 30 per cent in capacity.

The D. E. McNicol Pottery Co., Clarksburg, W. Va., manufacturer of Rockingham and yellow ware, is operating at full capacity with regular working force. Orders on hand insure this schedule for some time to come.

The Glenrock Brick Co., Glenrock, Wyo., is planning for the resumption of full-time production at its plant as soon as weather conditions permit, within the next 3 or 4 weeks. Continuous operations will be then scheduled for an indefinite period.

LEATHER—The Standard Kid Co., Wilmington, Del., is maintaining close to normal production at its local tannery, and is now running on a basis of about 850 dozen skins per day.

The William Amer Co., Philadelphia, Pa., is concentrating production on novelty leather at its local glazed kid tannery, with employment of regular working force. With the advent of spring, it is expected to revert to the manufacture of staples, with increased operations.

The American Hide & Leather Co., New York, N. Y., is advancing production at its different New England and Middle West tanneries, with increased working forces. For greater production in the New England district, the company has acquired the modern tannery at Peabody, Mass., formerly owned and operated by H. S. & M. W. Snyder, Inc., and will take possession early in April. It aggregates approximately 250,000 sq.ft. of floor area, and has facilities for an output of 1,500 dozen skins per day. The new owner expects to inaugurate production at the plant at an early date, with normal working quota.

PAPER—The International Paper Co., 30 Broad St., New York, N. Y., has established a capacity schedule at all of its newsprint mills for the first time in 2 years, and will continue on this basis for an indefinite period. Large working forces are being employed.

The Kennedy Car Liner & Bag Co., Shelbyville, Ind., is adopting a night shift at its paper products plant at Greensburg, Ind., using a portion of the working force heretofore employed at the Shelbyville mill, recently destroyed by fire and now being rebuilt. The extra working schedule will be continued for some time to come.

The Backus & Brooks Co., Kenora, Man., is planning to commence operations at its new local pulp mill, recently completed at a cost said to be close to $2,000,000. The plant has a rated capacity of 50 tons of material per day and it is purposed to develop operations at maximum, with full working force.

OIL—The Foco Oil Co., Franklin, Pa., recently organized to take over and operate the local refinery of the Lakeside Refining Co., is arranging for immediate production at the plant, with full working force.

Oil refineries in Western Pennsylvania are advancing production and adding to their working quotas.

The Sinclair Consolidated Oil Corp., 45 Nassau St., New York, N. Y., is operating at its Oklahoma, Kansas and other midwest plants on a production basis of about 35,000 bbl. per day. The Sinclair Crude Oil Producing Co., a subsidiary organization, has stock on hand at the present time totaling 30,000,000 bbl. of crude oil to be run through the refineries.

IRON AND STEEL—The Carbon Iron & Steel Co., Parryville, Pa., has resumed operations at its furnaces, which have been idle for more than 24 months past. Employment will be given to about 100 men.

Witherbee, Sherman & Co., New York, N. Y., have blown in the small blast furnace at their plant at Port Henry, N. Y., following relining and repairs, and purpose to keep the unit in service for an indefinite period. A larger furnace at the plant, now in course of construction, will be lighted as soon as completed.

Iron and steel plants in the Youngstown, O., district have advanced production to a point of about 90 per cent of capacity, the highest record for a number of months past.

The Gulf States Steel Co., Birmingham, Ala., is now operating five of its six blast furnaces, and will continue at maximum for an indefinite period.

The Sharon Steel Hoop Co., Sharon, Pa., is running at 100 per cent capacity at its local mills for the first time in 3 years.

The Bethlehem Steel Co. has resumed operations at the puddle mill at its Central Works, Lebanon, Pa., after an idle period of a number of months. The plant will be run on a double turn, and is said to have sufficient orders on hand to insure continuance on this basis for 6 to 8 months to come.

A total of 140 blast furnaces devoted to the production of pig iron are now in operation in the Pittsburgh, Pa., district. Practically all of the stacks that are idle are those devoted to merchant iron.

MISCELLANEOUS—The Carnegie Steel Co., is making ready to resume operations at its coke plant at the Farrell, Pa., works, which has been idle since March, 1921. Production will also be inaugurated at the benzol

and other byproduct plant units. Employment will be given to about 600 men.

The Ruggles & Raedemaker Co., Mainstee, Mich., operating salt properties, has taken over the plant and business of the Petit Salt Co., Milwaukee, Wis. The combined production makes the purchasing company one of the largest salt producers in the country. Full operations with regular working forces are planned.

The Ross-Meehan Foundry Co., Chattanooga, Tenn., specializing in the production of steel castings, is running at maximum capacity with full working force and will continue this schedule for an indefinite period.

Heavy production is in progress at the different lead and zinc properties in the Northeastern Oklahoma section. Practically every plant that can be operated profitably is on the full-time producing list.

# New Companies

THE BOND CHEMIST SHOP, INC., 338 Asylum St., Hartford, Conn., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical compounds. George L. Rapport is president; A. G. Bush, treasurer; and George L. Day, vice-president and secretary.

THE TUCKER CHEMICAL MFG. CO., Paducah, Ky., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are T. A. Miller, C. E. Pace and W. C. Richman, all of Paducah.

THE GOLDMAN PAPER & PAPER STOCK CO., Philadelphia, Pa., has been incorporated with a capital of $250,000, to manufacture paper products. Harry Goldman, 3207 Turner St., is treasurer.

THE CAMDEN GLASS WORKS, INC., Camden, N. J., has been incorporated with a capital of $10,000, to manufacture glass products. The incorporators are Harry Rosenthal, 105 Arch St., Camden; M. V. Mason and M. A. Maguire. The first noted represents the company.

THE AL-SANO CHEMICAL PRODUCTS CO., 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of $300,000, to manufacture chemicals and chemical byproducts. The incorporators are E. S. Fisher, Fern Warren and L. E. Sweitzer.

THE KING TIRE & RUBBER CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $1,500,000, to manufacture tires and other rubber products.

THE STAR PRODUCING CO., Albany, N. Y., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are W. H. Link and T. L. Hunt, Albany. The company is represented by W. M. Miller, attorney, Schenectady, N. Y.

THE CHESTER BRICK CO., Chester, Pa., has been incorporated with a capital of $50,000, to manufacture brick, tile and other burned clay products. Edward C. Burton, Chester, is treasurer.

THE UNITED STATES CHEMICAL CORP., Boston, Mass., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. Thomas L. Thistle is president; and Oliver E. Brusie, 1066 Commonwealth Ave., Boston, treasurer.

THE LEEDS CONCRETE PRODUCTS CO., Leeds, Ala., has been chartered under state laws to establish and operate a local plant for the manufacture of concrete brick, pipe and kindred products. H. M. Judge, Leeds, is president.

THE COLUMBIA PRODUCTS CORP., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture asbestos products. The incorporators are R. J. and Joseph Fnata, and Arthur W. Palmer, 5 Merchant Place, Newark. The last noted represents the company.

THE MONROE BOARD & LINING CO., Monroe, Mich., has been incorporated with a capital of $150,000, to manufacture paper products. The incorporators are William G. Gutmann, Fred J. Motz and J. Douglas Miller, 427 West Elm Ave., Monroe. The last noted represents the company.

THE HI-POWER CO. OF NEW JERSEY, INC., Hoboken, has been incorporated with a capital of $30,000, to manufacture battery fluids, chemical products, etc. The incorporators are J. D. and H. E. Pierson, and Rudolph Schroeder, 84 Washington St., Hoboken. The last noted represents the company.

THE CALUMET CASTINGS CORP., 11417 South Michigan Ave., Chicago, Ill., has been incorporated with a nominal capital of $5,000, to manufacture iron and other metal castings. The incorporators are Julius C. Greenbaum, William S. Newburger and R. Wagman.

THE LUBBOCK COTTON OIL CO., Lubbock, Tex., has been incorporated with a capital of $150,000, to manufacture cotton oil products. The incorporators are J. W. Simmons, Jr., F. J. Phillips and H. M. Simmons, all of Lubbock.

THE MACLEOD FOUNDRY CO., Detroit, Mich., has been chartered under state laws to manufacture iron and other metal castings. The incorporators are Casper Brown and Malcolm MacLeod, 1128 Marlborough Ave., Detroit.

TALENS & SON, INC., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. The incorporators are Hilbrand Talens, W. Howard Demarest and William M. Bosman, 985 Springfield Ave., Newark. The last noted represents the company.

THE BEMENT OIL CO., Terre Haute, Ind., has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are A. B. Bement, Ira E. Rogers and C. A. Morrison, all of Terre Haute.

THE OXICOL CORP., New York, N. Y., care of Briesen & Schrenk, 50 Church St., New York, representatives, has been incorporated with a capital of $100,000, to manufacture chemical products. The incorporators are S. J. Bohannon, B. Brehm and T. McErlean.

THE R. & K. GLASS CO., Wellsburg, W. Va, has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are W. D. Shields and A. J. Rowing, both of Wellsburg; and H. E. Kightlinger, Beech Bottom, W. Va.

THE AMERICAN CHEMICAL PRODUCTS CO., 315 New St., Newark, N. J., has filed notice of organization to manufacture and deal in chemical and oil products. The company is headed by J. William O'Connor.

THE BIRMINGHAM GLASS MFG. CO., 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of $250,000, to manufacture glass products. The incorporators are Harry C. Bryson, Richard T. Robb and E. R. Owen.

THE BACON HILL BRICK CO., Elkton, Md., has been incorporated with a capital of $50,000, to manufacture brick, tile and other burned clay products. The incorporators are John Mattiussi and James F. Evans, both of Elkton.

THE MONTEREY BAY PORTLAND CEMENT CO., care of the Corporation Service Co., Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture portland cement.

THE HOPEWELL COLOR & CHEMICAL CO., Hopewell, N. J., has been incorporated with a capital of $50,000, to manufacture chemicals, colors and affiliated products. The incorporators are Peter M. Horn, Edward and W. Herbert Jones, all of Hopewell. Edward Jones, Hopewell, is the registered agent for the company.

THE INDIANA SUN RISE OIL CO., Patricksburg, Ind., has been incorporated with a capital of $50,000, to manufacture petroleum products. The incorporators are J. M. Henderson, N. B. Love and James Andrew, all of Patricksburg.

THE STRADFORD MFG. CO., Philadelphia, Pa., care of the Corporation Guarantee & Trust Co., Land Title Bldg., representative, has been incorporated under Delaware laws with capital of $1,250,000, to manufacture chemicals and chemical byproducts.

# Capital Increases, etc.

THE NORTHERN INDIANA BRASS CO., Elkhart, Ind., has filed notice of increase in capital from $10,000 to $100,000 for proposed expansion.

THE ATLAS LEATHER MFG. CO., East St. Louis, Ill., has filed notice of change of name to the Atlas Board & Paper Co., and in the future will specialize in the manufacture of paper products.

THE GLENN-OSAGE OIL CO., Grand Rapids, Mich., has arranged for an increase in capital from $100,000 to $200,000.

THE HUDSON OIL CO. OF DELAWARE, 135 Broadway, New York, N. Y., has filed notice of increase in capital from $3,000,000 to $5,000,000.

THE BROUGHTON BRICK & TILE CO., Broughton, Ill., has filed notice of dissolution under state laws.

THE BROOKLYN COLOR WORKS, INC., Stewart Ave., Brooklyn, N. Y., has arranged for an increase in capital from $30,000 to $100,000.

THE ROSS-MEEHAN FOUNDRIES, INC., Chattanooga, Tenn., has filed notice of increase in capital from $60,000 to $1,260,000 for general expansion. G. F. Meehan is president.

THE STANDARD PAINT CO., Texarkana, Ark., has arranged for an increase in capital to $50,000 for proposed expansion. C. K. Faison is president.

THE HARRISBURG SHALE BRICK CO., Harrisburg, Pa., has called a special meeting of stockholders on April 14 to arrange for an increase in capital from $60,000 to $120,000 for general expansion. Jacob H. Foreman is secretary and treasurer.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., is disposing of a preferred stock issue of $14,505,800, a portion of the proceeds to be used for general financing, expansion, etc.

THE CHINO COPPER CO., 25 Broad St., New York, N. Y., is considering a new stock issue to total $150,000, the proceeds to be used for plant extensions and improvements.

# Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

**AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.**

**AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.**

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

**AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.**

**INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.**

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

**NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.**

SOCIETY FOR STEEL TREATING—Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

**SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."**

**A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.**

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.